Gas Journal

DECEMBER 22, 1937

Vol. 220 89th Year No. 3892

Editorial Notes

Fuel Research

THE extent of the field embraced by the work of the Fuel Research Board can be appreciated by reference to the Board's Report for the year ended March 31 last which has just been published. It is apparent from the Report that the closest co-operation between the Board and the Gas Industry is desirable. As an example of co-operation we have the work on the carbonization of cannel carried out jointly by the Edinburgh Gas Department and the Board, the results of which investigation to-date have been reported to The Institution of Gas Engineers—results which have significance nationally as well as to the Industry itself. The close relationship between many of the problems which are being studied at the Fuel Research Station and those which are being tackled by our Industry is clear from the Report, which will be widely read by those connected with the carbonizing industries. Reference to the collaboration with the Edinburgh Gas Department is made in the Report, a section dealing with the investigation concerned with the possibility of improving the quality of vertical retort coke made from Scottish bituminous coal. The main object was to determine whether it was possible under the conditions of gas manufacture to prepare in continuous vertical retorts satisfactory open grate fuels from weakly caking coals. Dr. J. G. King mentioned this interesting work in his William Young Memorial Lecture to the North British Association last September. The special coke made in this way has proved eminently satisfactory, and the investigation is being continued.

Another investigation of the liveliest interest is that on the complete gasification of bituminous coal in water gas plants. Obviously, if non-caking coals can be substituted for coke in the manufacture of water gas the flexibility of the process of gas manufacture is increased and it becomes possible for the Gas Industry to offer more coke for domestic and industrial purposes. This work was also described by Dr. King in the William Young Memorial Lecture, when he reported success with coals containing 17% volatile matter. At present the marked reduction in output of the plant using coal is a difficulty, but it appears probable that this difficulty will be removed as a result of further research. At the Institution Research Meeting, it will be recalled, Dr. King supplemented the information on this work, explaining that, by using a recuperator to assist in the cracking of the tar vapours, success has been achieved in treating bituminous coals of 30-40% volatile matter without having any tar troubles. The most important property necessary in the coal is that it should be in lump form and have only sufficient caking index to avoid disintegration in the fuel bed and to cohere without forming large masses of coke. The yield obtained with one "not too suitable coal" was 70,000 cu.ft. of gas of 304 B.Th.U. per cu.ft., equivalent to 210 therms, and it is confidently felt that the figures will show an improvement as a result of further experiment.

In the Report of the Board published last year it was stated that a setting of six narrow brick retorts in accordance with the design developed at the Fuel Research Station had been erected at Parkgate by the South Yorkshire Chemical Works, Ltd. The setting was first put to work in September, 1935, for the production of free-burning coke for the domestic market. The plant has proved very satisfactory, as has the smokeless fuel, which is sold under the trade name "Sycobrite;" and as a result of the experience gained the Company has decided to extend the plant, and a further six retorts are in course of erection.

In the section of the Report concerning the hydrogenation of coal it is mentioned that, in view of the interest taken in the utilization of cannel owing to the high yield of tar which it gives on carbonization, the behaviour of Newbattle cannel on hydrogenation was investigated. Comparison was made with the coal used as standard at the Station, and it was concluded that the cannel coal was not so completely convertible into oil. The quality of the oil, however, was interesting, since its boiling range was lower, in view of which it might be anticipated that the final conversion of the oil into motor spirit by vapour-phase hydrogenation would require less hydrogen than usual. Another interesting item recorded in the Report is the use of the "Multijet" burner developed at the Station for the burning of hard pitch as boiler fuel. It was suggested that pulverized pitch might be suitable

for this purpose, and a consignment was submitted for test. On the whole the indication of the investigation is that there is no reason why a technique should not be developed for using hard pitch in powdered form in boilers, if circumstances make this desirable. The "Multijet" burner has also been applied to gaseous firing. At the Fuel Research Station it was employed for heating a horizontal low-temperature retort setting, but there are many other applications in which use can be made of the characteristics of the burner, with which "blowing-back" cannot occur. There is, for example, the possibility of operating with a deficiency of air and yet maintaining a non-luminous flame, which is an advantage in processes requiring a clean reducing atmosphere. Similarly the burner can be employed in certain heating systems where an even temperature is maintained over a large area, by burning gas at one point with a deficiency of air and then gradually completing combustion by adding the requisite air in stages as the partially burned mixture passes through the heating flues.

The Board stress the importance of the treatment that coal receives before it reaches the consumer, and a considerable part of the Report is devoted to this aspect. "As industry becomes more exacting in its demands for coal of special qualities, methods of analysis have frequently to be reviewed and new tests devised to evaluate special characteristics. . . . The information gained by the Coal Survey is of basic importance to all users and producers of coal; it must be considered as a national service for which accuracy and thoroughness are essential." We quite agree, but the Gas Industry would feel a little more satisfied if it could obtain the quantity of coal of the quality it needs.

Another National Campaign

At the Conference of the British Commercial Gas Association in Manchester last September much discussion centred round the advantages of regional and nation-wide selling in the Gas Industry. We have for long pointed to the added strength and effectiveness of such co-operative sales effort; and the experience of those who have embarked on group marketing has been a happy one. Maybe there are times when individual policies do not allow of taking the fullest part in a particular marketing scheme, but one thing has been clearly proved—that the results which can be achieved as a body can never be equalled by the total of the results obtained individually. This is an accepted fact, and it is not difficult to devise ways and means of making group planning flexible, of a character such that all members can participate in the general effort. The public is mobile these days, and this makes repetition of the same appeal all the more effective. The same series of Press advertisements, the same posters, and where possible the same price appeal, produce results over an area which could never be equalled if five or six different advertisements, five or six different stories were being used locally.

Regional schemes, while being administratively and financially independent of national effort, could to great advantage link up from time to time with national drives; regional schemes, it has been shown, can do work which is outside the sphere of a national body and often quite beyond the scope of individual undertakings. We are strong believers in these intensive national campaigns, the fourth of which has just been announced by the B.C.G.A. This is to be a Gas Cooker Fortnight in February next. This series, it will be recalled, was commenced early this year, and the experiment has proved extremely successful. The policy of launching intensive direct-sales campaigns in the national and district newspapers, to be followed up and capitalized by individual undertakings in their own districts, has been fully justified; and it is to be hoped that next February every undertaking will pull its weight in the cooker campaign. The message of the national advertisements should be repeated and its effect reinforced by advertisements in local newspapers, by circular letters, leaflets, demonstrations, films, lantern slides, window displays, canvassing, competitions, newspaper articles. There is no doubt that the local campaign gains strength from the national appeal in a more direct way than was possible before. As a result of experience in this type of campaign the B.C.G.A. is building up a complete technique, and individual undertakings are able to draw upon the Association for supplementary means of publicity. In all this sales work it should be remembered that the Gas Industry is not only in competition with other fuel interests; it has indirect competition from the motor car industry, the radio industry, and so on, which are out for the public's money. These indirect competitors advertise on a scale far greater than does the Gas Industry, and it is essential that full benefit should be gained from the comparatively small amount which the Industry is prepared to spend on publicity. We suggest that these national drives, if adequately supported locally, constitute real value for money.

Good Service

The month of December may not be considered altogether the best time of year to give one's attention to the question of refrigeration service, but in a climate so changeable as ours there can be no season during which special care in the matter of food preservation should be regarded as superfluous. Indeed, mild, muggy days in winter must be fraught with their own particular possibilities of danger. Thus refrigerator service needs to be an all-the-year-round activity of the Gas Distribution Department.

And an admirable service it is; one upon which the Gas Industry is most fully entitled to congratulate itself, even though self-praise may usually be no recommendation. However, encouragement from within can hardly be so powerful an incentive to redoubled effort as encouragement from without, and we feel that many gas administrators and gas salesmen will be spurred on to further triumphs by expressions of appreciation from their business rivals. Such appreciation we have been pleased to notice recently in the correspondence columns of an electrical contemporary. The "ball was opened" by a writer describing himself as a service mechanic working every day in the electrical field, who pointed out that "the gas companies are sparing no effort to capture this useful load, and it seems that not yet has the electrical industry realized how thorough and intense these efforts are, and how far-reaching the gas advertising is." For example, this correspondent (who appended to the letter his name and town) asked whether it is realized that "at least one gas supply company will buy any electric refrigerator, if a gas model is supplied in its stead." A conversation with two gas fitters made it instantly apparent that "the gas refrigerator had been thoroughly

driven home to them, and, what is more, each had a commendable knowledge of the electric refrigerator—a proof of the thoroughness of their employers' training courses." This writer summed-up by expressing the opinion that "if the electric refrigerator campaign is not redoubled in intensity and efficiency, then, so far as that product goes, electricity will have to take second place in the home."

A week later an anonymous correspondent, referring to the letter just alluded to, suggested that the remarks "apply in many cases to all branches of the sales and service side of the industry, and there is no doubt our gas friends surpass us in both." In his own case, he had found that a domestic all-in tariff for electricity had been introduced, of which he had received no notification. He applied for particulars, filled-in the application form during the first week in November, and was advised that he was too late to be placed upon the tariff for the December quarter. He was reminded that he should read his local paper, and take an interest in his Council's activities. The writer adds that "these are unnecessary pinpricks which the Gas Industry carefully avoids. . . . In fact, the Gas Industry is a model to follow in all its dealings with consumers." Yet another correspondent, after pointing out what he thinks electricity salesmen should do, adds his contention, which coincides with our own, that the time to sell refrigerators is not just in summer, but also now.

So we have from our rivals the gratifying assurance that, not only does the Gas Industry give service, but, what is all-important, it is good service. Really good service cannot be judged upon theory alone; in the end it must stand upon results. That theory and practice do not always run side by side is shown by the report that a Corporation possessing an ancient and honourable history are intending to promote a General Powers Bill containing a clause empowering them to compel (under penalty of a daily fine) the occupier of any building from which a clock is suspended to remove this clock within 28 days of receiving notice from the Corporation that it is registering incorrectly. It seems that there is a growing tendency for traders to erect clocks in the streets over shops, and that as the number of clocks increases people get more and more confused about the right time, with the result that they miss trains and things are generally unsatisfactory. The traders argue that by providing a public clock they are securing a worth-while advertisement, but unless the service extends further, to the keeping of correct time, the effort has been wholly wasted. So it is with the Gas Industry; service must extend to the very utmost limit, if the effort is not to be, at least partially, thrown away.

Talks on the Gas Industry

THE Contributor of the series of articles under the title of "A Woman's Viewpoint," which for some time now has been a popular feature of the "GAS SALESMAN," has an interesting comment on talks on the Gas Industry in the "SALESMAN" published on Saturday last. It concerns addresses at Rotary meetings, but has, we suggest, a wider application. A Rotarian who travels about the country a good deal has, in conversation with the writer of the series to which we refer, mentioned that he has listened to several talks on our Industry and has been impressed with their similarity, the theme being constantly an outline of the process of making gas. He expressed the opinion that for the layman one talk of the kind was sufficient, and that, as a general rule, gas engineers fail to take full advantage of the opportunity provided by these Rotary club informal talks. Reports of such addresses arrive regularly at the "JOURNAL" Offices, and we, too, are struck with their similarity, the amount of attention given to the early history of the Industry and the time devoted to description of gas-works practice. There are, of course, notable exceptions.

Why, asked the Rotarian to whom we have referred, do not gas engineers single out picturesque features of their Industry, points likely to make a favourable impression on an audience of business men? Pointing out that a Rotary audience constitutes a first-class medium for the spread of new ideas, he said that what he personally would like to hear would be something about the Industry's selling problems and prospects. We think there is much point in this Rotarian's main contention. We feel that the gratitude we can inspire by these talks for what the Industry has accomplished in the last century and a quarter is of small value compared with an understanding of what the Gas Industry has to offer today and of its unlimited prospects. The developments made in recent years which have enabled gas to replace cruder fuels in fields hitherto considered beyond its scope might well be stressed, and methods of sales policy could be explained. Many of the commercial and industrial leaders who comprise membership of the Rotary Clubs may be—they probably are—unaware of the economic use they could make of gas. They may not be properly acquainted with the special tariffs their gas undertaking is prepared to offer for particular loads, of how well the Industry is organized to assist them in their problems, of how, for example, the resources of undertakings in an area are linked through Development Centres. There is undoubtedly need for emphasizing what our Industry can offer at present and how vast are the future possibilities of a gaseous heat service.

Forthcoming Engagements

1938.

Jan.

1.—LONDON AND SOUTHERN JUNIORS.—Visit to the Headquarters of the London Fire Brigade.
7.—I.G.E.—Joint Committee on Complete Gasification under Pressure, 3 p.m., at 16, Old Queen Street, S.W. 1.
8.—SCOTTISH EASTERN JUNIORS.—Visit to Milne's Meters, Ltd., Edinburgh.
13.—MIDLAND JUNIORS.—Meeting and Paper by A. T. Green.
15.—SCOTTISH WESTERN JUNIORS.—Debate meeting.
15.—YORKSHIRE JUNIORS.—Meeting at Leeds. Paper by W. S. Hubbard, "Choice of Gas Storage."
18.—LONDON AND SOUTHERN JUNIORS.—Meeting and Paper by R. T. d'Eyncourt, "Load Value of Appliances as a Guide to Sales Policy."
19.—B.C.G.A.—Executive Committee, 11.30 a.m.; General Committee, 2.30 p.m., Gas Industry House.
22.—WESTERN JUNIORS.—Meeting at Weston-super-Mare. Paper by A. G. Holtham, "Rural Gas Services."
27.—MIDLAND JUNIORS.—Visit to Docker Bros., Paint and Varnish Manufacturers, Birmingham.
29.—SCOTTISH WESTERN JUNIORS.—Visit to Glasgow Corporation Lighting Department.

Feb.

2.—LONDON AND SOUTHERN JUNIORS.—Visit to Watson House.
3.—MIDLAND JUNIORS.—Meeting and Paper by G. Bakewell, of Birmingham, "The Sale of Coke for Domestic Purposes."
5.—SCOTTISH EASTERN JUNIORS.—Short Paper Meeting at Dunfermline.

Personal

The Directors of the Wellington (Salop) Gas Company (a member of Severn Valley Gas Corporation, Ltd.) have made the following alterations in staff appointments to take effect as from Jan. 1, 1938. Mr. H. J. WOODFINE is to be relieved of his responsibilities as Engineer. He will devote the whole of his time to administrative and secretarial duties and will retain his position as Managing Director.

Mr. CECIL H. WOODFINE, who has filled the position of Assistant Manager over the past five years, will succeed his father as Engineer, with charge of the Company's Works, Storage Stations, Mains, &c.

Mr. HAROLD DAVIES, Chief Clerk, has been appointed Accountant to the Company.

* * *

The Council of the Institution of Civil Engineers announce that, having considered a large number of applications for the post of Secretary to the Institution, they have appointed Mr. M. E. GRAHAM CLARK, M.C., B.Sc., Assoc.M.Inst.C.E., to this position in succession to the late Dr. H. H. Jeffcott.

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The Council of the British Association for Commercial and Industrial Education, in accepting with much regret the resignation of Sir FRANCIS GOODENOUGH, C.B.E., as Chairman of the Council, which office he had held since 1932, paid warm tribute to the work Sir Francis had done for commercial education generally, and for the Association in particular, and unanimously elected him Honorary President of the Association.

Obituary

We regret to announce the death of Mr. HUBERT BERRY KNOWLES, Engineer and Manager of the Padiham Gas Department, on Dec. 12.

News in Brief

CURRENT EVENTS IN THE GAS INDUSTRY

The Leipzig Spring Fair opens on March 6. While the Great Engineering Fair and Building Fair continue until March 14, the General Samples Fair concludes on March 11.

The Coal Utilisation Council have now left British Industries House. Their address is: Grosvenor Gardens House, Victoria, London, S.W. Telephone: Victoria 4366 (4 lines). Telegrams: Promocoal, Sowest, London.

Wire-Wound Gas Containers, Ltd., is the name of a recently registered private Company with a nominal capital of £50,000. The Company, whose offices are at 25, Abchurch Lane, E.C. 4, are manufacturers of, and dealers in, gas containers, &c.

By the Industrial Use of Gas instead of coal, said the Minister of Transport, Mr. Leslie Burgin, addressing a meeting on national health at Coventry on Dec. 11, the City, although of great size, had kept its atmosphere clean and obtained a fine level of health statistics.

A Donation to the Special Book Fund of the Department of Coal Gas and Fuel Industries at the University of Leeds has been made by the Society of British Gas Industries. The object of this fund is to enable the library to purchase books and periodicals especially suitable for the Department.

Members of The Institution of Gas Engineers will be welcome at a Special Meeting of the Institution of Heating and Ventilating Engineers on Wednesday, Jan. 5, 1938, at 7 p.m. in the Meeting Hall of the Institution of Mechanical Engineers, Storey's Gate, S.W. 1, when a Paper will be read by Mr. Thomas Chester, Wh.Ex., M.Amer.Soc. Mech.E., on "Air Conditioning Factors."

Judgment with Costs was given by Judge Hurst in favour of the Chew Magna Gas Company, against Major Andrew Boswell, Public Works Contractor, of Wolverhampton, at Bristol County Court recently. A similar action against the Somerset County Council was dismissed. The case resulted from the fact that certain gas pipes belonging to the Chew Magna Company were damaged.

Electricity Failures occurred in various parts of Scotland on Dec. 13, Inverness, Perth, and Edinburgh being among the districts affected. At Inverness the whole electricity supply was cut off about 8 a.m. Some parts of the town had light restored within half an hour, but in other parts a supply was not available until after 10 p.m. A fault at Murrayfield sub-station, Edinburgh, deprived many Edinburgh householders of electricity. The breakdown occurred shortly after 8 a.m. and repair work occupied several hours. A complete black-out was experienced at Perth, Scone, and other nearby districts.

Gas Industry Films were shown during the second week in December to the townspeople of Cambridge. Arrangements were in the hands of the Cambridge University and Town Gas Light Company, whose enterprise was rewarded by large audiences at all seven performances. Children's performances proved very popular, and it can be safely said that Mr. Therm has left behind him not only a catchy chorus, but an excellent impression upon the young folk of Cambridge.

At the Christmas Show of the Liverpool and District Livestock Society, held at Stanley Cattle Market, Liverpool, on Dec. 14 and 15, the Liverpool Gas Company had one of the most attractive stands and showed how gas could be used with advantage for many operations in connection with the sterilizing of dairy appliances. They had on view a gas sterilizer with steaming stool made especially to meet the needs of modern dairymen. It was stated that by using gas steam is raised more rapidly than by any other method and that 320 bottles can be sterilized in 35 minutes, at a cost of 3d. In the back of the show premises where the milking trials took place the heating of the shippon was by means of gas panel heaters.

Following Recent Introduction of Gas at France Lynch the Stroud Gas Light and Coke Company, in co-operation with Radiation Ltd., recently arranged a series of cookery demonstrations. These lectures were well-attended and considerable interest was shown by the consumers, especially in the complete dinner consisting of four courses cooked in the oven without attention, and many questions were asked. Miss Jaques, of the Radiation Research Kitchen, who gave the demonstrations, convincingly proved how easily and cheaply cooking is done by gas. The success of the exhibition and lectures was due in no small measure to the energetic way in which Mr. W. Barber, Sales Manager of the Stroud Company, planned the whole proceedings.

A Low-Temperature Plant is to be erected on the edge of the South Welsh coalfield at Wern Tarw, Bridgend, by the South Wales Coalite Company, Ltd. The foundation stone of this plant was laid on Dec. 16 by the Earl of Dunraven. The Government and the Nuffield Trust have provided half the required capital of £650,000 for the undertaking which is the first to be established in a Special Area. The plant is expected to be working by the autumn of next year, and already contracts have been placed amounting to several hundred thousand pounds. There will be produced smokeless fuel, petrol for the Royal Air Force and motorists, diesel oil, tar acids, and other by-products. Two nearby collieries, Wern Tarw and Raglan, which are 2,000 acres in extent, will supply coal which extensive tests have shown to be suitable for treatment by low-temperature carbonization. Between 500 and 750 tons of coal will be used a day.

Amalgamation and Grouping

United Kingdom and Rossendale.

Rossendale Union Gas Company has received from the United Kingdom Gas Corporation an offer to purchase 10% fully-paid ordinary shares of £10, or fully-paid 10% preferred ordinary shares at £21 5s. in cash, or 20 ordinary shares of £1 each in the Gas Corporation, *plus* 10s. cash.

For 7% fully-paid ordinary shares the offer is £14 17s. 6d. each, or 14 £1 shares in the Gas Corporation and 7s. cash. Proportionate offers are made for shares not fully paid.

National Gas Council

Meeting of the Central Executive Board

A meeting of the Central Executive Board of the National Gas Council was held at Gas Industry House on Tuesday, Dec. 14, 1937.

Sir DAVID MILNE-WATSON, Bart., LL.D., D.L., Chairman of the Board, presided.

At the commencement of the meeting the Chairman referred with regret to the death of Sir John Ferguson Bell, formerly Chairman and Managing Director of the Derby Gas Light and Coke Company, and of Mr. R. E. Gibson, late Chief Engineer of the Liverpool Gas Company. Both these gentlemen had been associated with the National Gas Council from the earliest days, and members of the Board stood in silence in token of sympathy.

The following among other matters were considered:

Coal Position.—It was reported that the Coal Mines Bill had been introduced by the Government, but that while this Bill made some amendment in the constitution of the Committees of Investigation and the procedure relating thereto, it was felt that further protection was necessary in order to safeguard consumers.

Reference was made to the action which the Council had taken since the introduction of the Bill in Parliament, and to the fact that a large number of other organizations had expressed themselves largely in accord with the attitude adopted by the Conjoint Conference.

Ninth Annual Report of Central Electricity Board.—A memorandum with regard to this Report had been circulated, and it was indicated that while the financial position of the Board had improved very materially, it was not possible to forecast what the financial position of the Board would be in 1940.

Air-Raid Precautions Bill.—It was reported that the Air-Raid Precautions Bill had been introduced by the Government and had completed its passage through the House of Commons.

While the Bill dealt solely with local authorities, the Government had stated that they proposed at an early date to indicate the policy they intended to adopt with regard to statutory companies.

It was also stated that amendments exempting the land of Public Utility Undertakers from compulsory purchase had been incorporated in the Bill on Committee stage.

Hire-Purchase Bill.—The Chairman stated that a Private Member's Bill dealing with the law relating to hire-purchase had been introduced in the House of Commons, and had received a Second Reading.

It was agreed that the promoter of this Bill should be approached, and that every endeavour should be made to secure suitable protection in the Bill for Public Utility Undertakers.

Royal Commission on the Geographical Distribution of the Industrial Population.—It was reported that a Royal Commission had been set up to consider the question of the distribution of the industrial population of Great Britain and the probable direction of any change in that distribution in the future. Evidence had already been given before this Commission on behalf of the Electricity Industry, and it was agreed that evidence should also be offered on behalf of the Gas Industry.

Gas Gallery at South Kensington Science Museum.—It was reported that contributions had been received from gas undertakings and firms of contractors towards the Gas Gallery which is to be erected at the South Kensington Science Museum, and it was decided that an appeal should be sent out to the Industry asking for support for this exhibit.

British Gas Federation.—It was announced that the Rt. Hon. Lord Kennet had agreed to become the Vice-President of the Federation.

It has been decided that the Dinner of the Federation should in future be held every alternate year, and that the next Dinner should take place in 1939.

Conjoint Conference of Public Utility Associations.—It was announced that the Sixth Annual General Meeting of the Conjoint Conference would take place at 3 o'clock on Jan. 27, 1938, and that the President, Lord Mount Temple, would preside.

The following gentlemen were appointed as representatives of the National Gas Council to serve on the Council of the Conjoint Conference: Mr. R. Halkett, Alderman Sir William Kay, J.P., Mr. T. Hardie, M.Inst.C.E., Mr. A. W. Smith, F.C.I.S., and Mr. H. C. Smith, M.Inst.C.E.

It was also agreed that the other vacancy should be filled by a representative of a Scottish Municipal Undertaking.

British Gas Federation

Meeting of the Council

A meeting of the Council of the British Gas Federation was held at Gas Industry House on Dec. 14, Sir DAVID MILNE-WATSON, Bart., LL.D., D.L., Chairman of the Council, presided.

Acceptance by Lord Kennet of Vice-Presidency of the Federation.—It was reported with great satisfaction that Lord Kennet, P.C., G.B.E., D.S.O., D.S.C., had agreed to become a Vice-President of the Federation.

Proposed Gas Exhibit at South Kensington Science Museum.—A report was submitted by the Committee appointed to consider this matter, and the details of the proposed exhibit were approved by the Council. An appeal for funds will shortly be issued.

Supply of Steelwork for the Gas Industry.—In consequence of the statement considered at the Third Annual Meeting of the Federation on Nov. 3, 1937, with regard to the difficulty experienced by members in obtaining supplies of steel for necessary works, a communication was sent to the Secretary to the Committee on Supplies of the British Iron and Steel Federation drawing attention to the matter. A reply has been received in which the Committee has expressed willingness to consider sympathetically any details brought to its notice in cases where difficulties in regard to steel supplies were delaying work of national importance.

Street Lighting and Trunk Roads Act, 1936.—The Council considered the Final Report of the Departmental Committee on Street Lighting of the Ministry of Transport, dated August, 1937.

The Joint Lighting Committee of The Institution of Gas Engineers and of the Lighting Section of the Society of British Gas Industries was asked to keep the Members of the Federation informed in this matter, and to render all possible help.

Report of Exhibitions Committee.—A report of the Exhibitions Committee was considered, and approval given to the holding of a Gas Conference during the Empire Exhibition to be held in Glasgow from May to October, 1938.

British Gas Federation Dinner.—The Council decided that this event should in future be held every alternate year. The next Dinner of the Federation will therefore be held in November, 1939.

Cannon Iron Foundries, Ltd.

The report of the Directors of Cannon Iron Foundries, Ltd., states that for the year ended Sept. 30, 1937, the net profit after charging all expenses (including depreciation and Directors' fees) and reserve against British Government securities is £52,956, to which must be added the amount brought forward from last account (after dealing with the appropriations approved by the shareholders at the last general meeting)—viz., £10,959, making £63,916. From this amount there falls to be deducted: The dividends already paid or provided for on the preference and ordinary shares as per the profit and loss appropriation account amounting to £17,659 and income-tax and National Defence contribution, £18,393—£36,053, leaving £27,863 available for distribution. The Directors recommend that the dividends already paid be confirmed and that the above amounts be dealt with as follows: In paying a final dividend on the ordinary shares of 5% (less income-tax), making, with the interim dividend already paid, 10% (less income-tax) for the year, £9,375; in transferring to general reserve, £5,000; in transferring to reserve for taxation, £2,500; and in carrying forward to next account, £10,988—£27,863.

Continental Cookery Demonstrations

In these days of easy travel, the housewife, having tasted interesting and piquant dishes abroad, returns with the desire to introduce some of these into her own home menus. Bearing this in mind, Radiation Ltd. have arranged a programme of Cookery Demonstrations of a Continental nature. These lectures, organized in suitable towns, are being given by Miss Hilde Zimmermann, who is attached to the Radiation Research Kitchen. The Menu Card, designed as a British passport, is the housewife's invitation to these Continental Cookery Demonstrations, and is supported by a Window Bill and Showroom Display for the gas undertakings' windows. Reference to a series of these Demonstrations held recently at Reading was made on p. 857 of last week's "JOURNAL."

Gas Light and Coke Company's Charges

Increased to Meet Rising Costs

The Gas Light and Coke Company announces that, owing to substantial rises in wages and the cost of metals and materials, the price of gas will be increased by 3½%—*i.e.*, from 8·7d. to 9d. a therm, from Jan. 1. These figures apply to the central area, and a corresponding increase will take effect in the differential price areas.

Sir David Milne-Watson, Governor of the Company, said that it was with the greatest reluctance that the Directors had reached their decision. "Within the last 18 months," he said, "labour costs have gone up by 6% as a result of a national agreement with the trade unions, while the cost of steel and other metals and material used in the manufacture and supply of gas has increased by more than 15%.

"For a typical slot meter consumer the rise will amount to no more than a ½d. a week, while for an ordinary consumer with a gas bill averaging from 25s. to 30s. a quarter the increase will be less than 1d. a week."

A Hundred Years of Service

Cardiff's Centenary Dinner

The centenary dinner of the Cardiff Gas Light and Coke Company was held at the Park Hotel, Cardiff, on Dec. 16, Mr. Robert H. Williams, J.P., Chairman of the Company, presiding.

Mr. J. Evans Jenkins, proposing the toast of "The Company," traced its history during its 100 years' existence, and said it had rendered good and faithful service to the public. Its supplies had been a vital necessity to the community. He referred to the fact that the present Chairman was a grandson of the first Chairman, and founder of the Company, Mr. Charles Crofts Williams. "The Company is now looked upon as one of the most up-to-date public utility undertakings in the country," he said.

Mr. Robert H. Williams, responding, stressed the necessity for employees to pay attention to the athletic activities run under the Company's auspices.

The toast of "The Directors" was proposed by Mr. H. D. Madden, Engineer and Manager, and responded to by the Deputy-Chairman, Mr. James Miles, J.P.

Mr. Bertrand Turnbull, a Director, proposed the toast of "The Staff," and Mr. R. J. Auckland responded.

New Books

Conveying Machinery*

In this book many important types of conveying plant are dealt with, the text being amply illustrated by diagrams, scale drawings, and photographs. The volume is a record of first-hand experience, the Author himself having been responsible for the construction of many of the conveying plants described. Conveying machinery does, of course, play an important part in the Gas Industry and is by no means confined to gas and coke making installations. The book is well written and includes a comprehensive bibliography of references to books, papers, and technical articles of value to conveyor engineers. There is a lengthy chapter describing numerous types of conveying chairs which will prove helpful to both designers and users of conveyors and elevators. A full table of densities of bulk materials adds to the general usefulness of the book.

* "Conveying Machinery," by W. H. Atherton M.Sc., M.I.Mech.E. Published by The Technical Press, Ltd., 5, Ave Maria Lane, E.C. 4. Price 21s. net.

Petroleum Technology in 1936*

In all industries a book summarizing recent developments in an orderly and comprehensive manner, is of the greatest value to the technologist. This requirement is fully covered for the petroleum industry by a volume recently published by the Institution of Petroleum Technologists, which reviews progress during 1936 and provides extensive references to original literature. "Petroleum Technology in 1936" presents a survey of all sections of the industry—geology, prospecting, drilling, transport, refining, cracking, testing, and utilization of the numerous products of petroleum. The wide scope of the book is indicated by the inclusion of lengthy chapters on coal and shale carbonization, motor benzole, hydrogenation, synthetic fuels, oil engines, and automobile engines.

* "Petroleum Technology in 1936." Published by the Institution of Petroleum Technologists, Aldine House, Bedford Street, W.C. 2. Price 8s., post free.

Edinburgh's Gas Consumption Rises

New Record Established

The wild weather of the past week has seriously affected business among shopkeepers in Edinburgh, but this has not been the experience of the Gas Department. On the contrary, the output has gone up very considerably, the average increase daily being round about 10% to 12%. One day last week, an output record for twenty-four hours was established when 16,690,000 cu.ft. were sent out. The previous record was on Dec. 23, 1935, and should the prevailing weather continue, the new record will probably not stand long. Since the beginning of the Department's financial year, the increase in output is no less than 75 million cu.ft. In addition, orders for heating appliances are being booked at an unprecedented rate, special arrangements being made for speedy fixing.

The New Showrooms at Lewes

This photograph shows the attractive interior of the Lewes Gas Company's new showrooms, a description of which, together with a report of the official opening by the Mayor, was published on p. 857 of last week's "JOURNAL."

A Technical Salesman's Observations on District Work

by
R. J. K. SHEPHERD,
of Swansea

From a Paper delivered at a meeting of the Wales and Monmouthshire Junior Gas Association at Swansea on Nov. 20, the PRESIDENT (Mr. H. V. Williams, Cardiff) in the chair.

What is district work? Is it going round picking up orders from people who have expressed a desire for certain appliances, or, rather, instilling into people's minds the desirability of gas appliances for specific purposes, especially those who are antagonistic to gas for any purpose? The latter, to my mind, is the true function of district men.

District men should not only be technically trained, but be possessed of a knowledge of psychology and have an abundance of tact and good humour. How often has one got on the right side of a peevish and truculent consumer by referring casually to the wireless, piano, or other popular topics, and for a few moments discussing these questions, and then turning the conversation round to the matter of the call.

District men have a wonderful opportunity of building up the confidence of consumers in their undertaking. May I suggest three ways in which this could be done:

(1) By showing the safety and efficiency of the appliance, resulting from expert installation.
(2) By the assurance of satisfactory service and maintenance schemes.
(3) By pointing out to the consumer that the appliance was made by a manufacturer of high repute, under sound modern methods of production, coupled with high standard of workmanship.

You can advertise and send circulars with covering letters as long as you like, but without personal contact the desired results are not obtained. While we district men are supported with liberal advertising, modern showrooms, and good apparatus, these in themselves will not get the business. We must have personal contact, but personal contact without specialized knowledge will lead nowhere. That is why I am stressing the need for knowledge concerning the manufacture, functions, and performances of appliances.

District men should be *au fait* with comparative values of various fuels. They should also be fully acquainted with all the schemes, rules, and regulations that have been arranged by the management for the pushing of gas appliances. By this I mean knowledge of the various tariffs and block rates that are in operation, such as operate for bakers, central heating, and industrial work, together with prices of various appliances, cash or deferred payments, methods of fixing, running of supplies, sizes of necessary piping and best positions of apparatus, and so on.

I will now touch on the practical side and deal with complaints received from consumers.

Cooker Complaints.

(1) *Oven smothering.*

On investigation in many cases we find:

(*a*) Excessive gas consumption on oven burners giving incomplete combustion, due to lack of primary and/or secondary air in oven.
(*b*) *Stoppage in flue outlet*, due to accumulation of rust or grease, and sometimes owing to a consumer having stuffed the end of the flue outlet with rag or paper to prevent down-draught. This is, of course, very rare, but is referred to as it sometimes happens.
(*c*) Overloading of oven with foodstuffs thereby impeding the flow of products of combustion away to the flue outlet.

All these complaints are easily remedied.

(2) *Fruit tarts are not cooked underneath.*

On investigation we find that the wrong type of plate has been used, this preventing the heat from getting to the bottom of pastry. We advise using thinner plates, preferably metal, due to their better conductivity of heat.

(3) *Grill plates smoking and smelling badly.*

On investigating we find that the consumer has allowed the grill plates to become coated with grease, with the result that when they are used for grilling or toasting the heat burns the fat, with consequent smell and smoke. In this case we advise consumers never to leave the grill plates in position, except when required for use. It should be noted that grill plates never collect grease when they are in use, but when they are not in use.

(4) *Boiling burners operating with a yellow flame.*

On investigation we find in the majority of cases that this is due to consumers taking out the burners to clean them, and in doing so altering the adjustment of the air control. This does not happen when the adjustments are incorporated in the taps. Another cause is that burners are choked with grease through lack of cleaning.

(5) *Noisy burners.*

This is merely a matter of correct aeration of the burners, and is easily remedied.

Gas Fire Complaints.

(1) *Fire smells.*

On investigation we find fire burning with a yellow flame caused by:

(*a*) The burner teats being choked up with cigarette ash.
(*b*) The choking of the injector which is caused by not cleaning the dust from underneath the fire fender, the air input to the burner having become covered with particles of dust and fluff, due to the natural pull of air currents underneath fender to the burner inlet.

Both these complaints are easily remedied.

(2) *Down-draught.*

This, of course, is caused by a defective chimney and can sometimes be cured by the use of special cowls. It would therefore seem obvious to us as district men to make certain when selling a gas fire that the chimney has the necessary pull to ensure satisfactory working of the fire. The fixing of a gas fire is no cure for a defective chimney.

(3) *Inadequate heating of a room.*

On investigation we find this caused by:

(*a*) Chokage in gas supply pipe to fire which, of course, is easily remedied.
(*b*) Fire too small for room. This latter reason generally occurs when a consumer purchased and had fixed privately a gas fire which is definitely too small. It should be pointed out that our practice is to investigate condition of grate, size of room, &c., before accepting consumer's order—*i.e.*, while we encourage consumers at showrooms to select the *type* of fire, the size is finally determined when the foreman calls to take particulars of piping necessary for fixing. This practice ensures that a fire of suitable size is always installed.

(4) *Expense of using fire.*

Some consumers after having a gas fire installed complain of its high running cost, compared with what they understood the cost would be. This is something we should all guard against. We have a test meter at the showrooms to which we can attach any appliance and so illustrate to consumers what the consumption really is. I believe that, when selling any appliance on the district, whether it be for cooking, water heating, or space heating, it is always a good policy to over-estimate the gas consumption rather than under-estimate it.

Water Heaters.

I should say that the chief complaints relative to water heaters are:

(*a*) Water not hot enough.
(*b*) Flow too small, with the result that when the bath water is ready it is only lukewarm.

Up to a short time ago it was not uncommon to find

private plumbers fixing gas-heated water appliances, and in their desire to cut down estimated costs they fixed piping of an inadequate size, with the result that the volume of gas was not sufficient to ensure satisfactory working of appliance. When this occurs, the only remedy is to recommend the consumer to allow us to install piping of an adequate size. When gas undertakings fix water heaters this complaint naturally does not arise. Bath water heaters which are fixed in the summer-time may work efficiently, but when winter comes the consumer may complain of inadequately heated water.

Where initial water flow is too small, this is often found to be due to three or four houses being fed off the same water service. This is, of course, a complaint for the local water department.

In the new type of instantaneous water heaters, sink or multi-point, complaints are sometimes received that after turning on the water the main burner will not light. On investigation we find that the by-pass orifice has become slightly choked, with the result that the flame operating the bi-metallic strip is not large enough to operate it. Consequently, the full gas way to the main burner is not opened. This is, of course, easily remedied.

Fortunately in the Company I represent complaints regarding water heaters are few and far between, as we have a very efficient maintenance staff. It has been stated that maintenance visits suggest to consumers that we are not quite sure of the appliances we sell, but our experience is that we are welcomed, and an opportunity is afforded during the visit to recommend other appliances.

Again, complaints may be received regarding the storage type of water heater. The general complaint is that the temperature of water is not high enough. On investigation we find that the gas has cut off to by-pass before water has attained desired temperature. This can easily be put right by the readjustment of the thermostat. In relation to thermostat and stand-by by-pass flame or burner, a warning is necessary. Ensure that the stand-by flame is not more than is actually required to maintain temperature, or you will receive complaints of excessive consumption.

Discussion.

The PRESIDENT (Mr. H. V. Williams, Cardiff), congratulating the Author on his Paper, said that there was a great deal of scope for portable heaters in flueless rooms.

Mr. W. T. VINEY (Cardiff) said that a fitter visiting a home and finding a ½-in. pipe in a room should not take this as an indication of the size of the supply pipe, as very often it would be found that the ½-in. pipe would be connected to a ¾-in. pipe with the result that insufficient gas would be passing, even though the correct size of pipe was installed. It was the policy of the Cardiff Gas Light and Coke Company to co-operate with builders in order that the right size supply pipes should be fitted, as it was very often found that builders would put in small ones in order to cut down building costs.

Mr. H. L. JONES asked what was the usual procedure in Swansea for estimating the size of a gas fire.

Mr. SHEPHERD, in reply, said that the size of the room, heat losses, and number of air changes per hour were determined.

Mr. H. MAYCOCK (Abertillery) said that gas was cheaper, not so much due to price, but to its merits. He suggested that the simmering burner should be placed at the back of the cooker hotplate.

Mr. SHEPHERD said that this would be a good practice, as it would ensure easier access to the other boiling burners on the hotplate which might be in use at the same time.

Mr. H. S. BARTLETT (Cardiff) recommended the B.C.G.A. Course on "Domestic Gas Salesmanship" as it was no doubt of great use to all gas salesmen. He asked what was the practice in Swansea with regard to the fixing of ring burners on electric cookers.

Mr. SHEPHERD said that it was the practice in Swansea to fix, free of charge, two gas ring burners for the purpose of speeding up the boiling on an electric cooker, and that it was also a means of keeping in contact with the consumer with a view to making them return to gas cooking.

Mr. I. G. JENKINS (Cardiff) proposed a vote of thanks to Mr. Shepherd for his Paper and Mr. A. E. PASK (Caldicot) seconded.

R. J. Milbourne on "Juniors"

Midland Juniors at Birmingham

At a meeting of the Midland Junior Gas Association held at the Council House, Birmingham, on Dec. 2, Mr. F. A. C. Pykett, Distribution Engineer, Coventry Gas Department, read a Paper entitled "Retaining the Cooking Load by Vitreous Enamelling."

Before calling upon the Author for his Paper, the President, Mr. E. T. Pickering, B.Sc., A.I.C., Birmingham Gas Department, welcomed to the meeting Mr. R. J. Milbourne, who attended to present the Milbourne Medal to Mr. W. N. Smirles for his Paper given before the Midland Junior Association last session.

In making the presentation, Mr. Milbourne said he welcomed the opportunity of visiting the Association again to present the medal to Mr. Smirles who, if his memory served him right, had won the medal on a previous occasion. He had read Mr. Smirles' Paper, and as it had been submitted to Major F. J. Bywater, for whom he had the greatest admiration, for adjudication, he was sure the selection was a good one.

He went on to say that the vigorous enthusiasm of the Midland Junior Gas Association, the quality of the Papers, and the discussions which followed them, were, in no small measure, a source of inspiration and profit to the Gas Industry, and helped to give the "Seniors" the fullest confidence in the future of the Gas Industry's personnel. He was certain that the Industry appreciated the value of the reports which the Technical Press gave to the Junior Association's proceedings and Papers, and felt sure they were read by all sections of the Industry who were keenly interested in its progress. The reading of the Technical Press was as much a part of a "Senior's" job as reading his morning business letters if he were to be fully aware of current developments and general progress.

Mr. LeFevre, who presided at the Junior Gas Associations' Joint Council meeting recently held at Watson House, brought forward a suggestion for the elimination of the word "Junior" from the title of these Associations, and a resolution was passed asking The Institution of Gas Engineers to submit an alternative title. The main plea for this alteration was that so many senior members of the Industry held office in the Junior Associations, but he thought that if there were a case for revision it might be further strengthened by giving due consideration to the quality of the Papers, discussions, and (by no means least) the season's stimulating Address given by the President each year. The word "Junior" might appear to be a misnomer in many respects, but its deletion would cause some difficulties, while at the same time there were distinct advantages in other directions by its retention. As the Junior merged into the Senior, by almost imperceptible degrees of time, it might be difficult for The Institution of Gas Engineers to draw a definite line of demarcation between the two classes.

He thought that the importance of the Junior Gas Associations would be enhanced, and their status improved, if they were counted worthy of inclusion in the list of associated organizations which form the British Gas Federation, and thus complete the whole of the organizations connected with the Gas Industry.

It was very gratifying to find that many members still retained their connection with the Junior Associations, even after they had advanced to senior positions. No doubt they recognized that, whether classified as "Seniors" or "Juniors," there was always something to learn, and that they must always be ready to gain up-to-date knowledge and enlightenment on any new problem or process, from whatever source it might spring. No one occupying a high position of responsibility, however brilliant or however varied his experience, could hope to maintain his position successfully unless he was prepared to continue to learn and move with the times. If anyone were content to live in the past, or allow his mind and ideas to become static, then it would appear advisable that he should retire into private life.

The senior members of the Industry felt the need for a constant supply of young men, not only proficient in the technology of gas, but also trained in the principles of management and routine supervision, and they therefore considered it a pleasure and duty to assist and encourage those members of the Junior Associations who were in line for promotion, and upon whom, in the none too distant future, more exacting responsibilities would be placed.

He knew that The Institution of Gas Engineers would give full and sympathetic consideration to the problem and proposal, and that their final decision would eventually prove to be in the best interests of the Junior Associations and the Gas Industry generally.

He then presented the medal to Mr. Smirles, who, returning thanks, said it was an incentive to future service as much as a reward for services rendered.

Heat Utilization in Carbonizing Plants

By
JAMES W. REBER,
of the Research Section of the Woodall-Duckham Companies.

From a paper read before a meeting of the London and Southern District Junior Gas Association on Nov. 23—the PRESIDENT (Mr. R. N. LeFevre, of the Gas Light and Coke Company) presiding.

Introduction.

As indicated by the title, this Paper deals with the heat distribution in carbonizing plants, from the formation of the producer gas onwards to its combustion, with the heat required for the carbonization of the coal, and with the methods of utilizing the surplus heat in the most economical manner. The final section includes a short paragraph on chimney calculations.

There is a distinct difference between a thermal balance of carbonization and the actual heat balance of a retort setting, in which carbonization takes place. In carbonization, the potential heat recovered in the form of gas, tar, and coke should, in the absence of endothermic or exothermic reactions, be equivalent to the potential heat value of the coal, as carbonization is simply a process of conversion of energy.

The actual heat balance indicates the distribution of the heat supplied for the carbonizing process. As carbonizing and underfiring are entirely separate processes, they should not be included in the same heat balance, as very often has been the case. The only connections between the two processes are, firstly, that the carbonizing time depends on the temperature of the combustion gases in the heating flues and, secondly, that the amount of heat actually transmitted through the heating walls into the retort is, in the absence of endothermic and exothermic reactions, equivalent to the total sensible heat of the products leaving the retort. Only in the cases of water gas manufacture and complete gasification are the two processes of gas production and heat supply intimately related to each other. These two processes are, however, outside the scope of this Contribution.

This Paper is sub-divided into the following Sections:

1. The production and composition of producer gas.
2. The process of combustion.
3. Heat requirements of carbonization.
4. Surplus heat utilization, waste heat boilers.
5. Heat balance, based on simplified methods.
6. Chimney calculations.

As each one of these items could provide ample material for an independent Paper, the Author has been obliged to present this Contribution in a compact form in order to bring it within the scope of a Paper of reasonable length.

I. The Production and Composition of Producer Gas.

(*a*) *Fuel, corrected from wet to dry.*—The fuel consumption of a carbonizing plant can be expressed either in terms of wet, dry, or dry ash-free coke. As a certain amount of carbon is lost in the pan ash, the dry volume of producer gas is preferably calculated per unit weight of dry ash-free coke gasified, the actual volume per lb. of coke as charged being corrected for carbon loss, ash in the coke, and water vapour in the gas, the latter being due to undecomposed steam and to moisture in the coke, if present. If the producer gas is made in mechanical producers and cooled to approximately atmospheric temperature, then obviously no correction is made for moisture in the gas.

As, however, the settings are, with very few exceptions, supplied with hot producer gas from the usual type of step-grate producers either built into the settings or in the form of battery producers, the moisture content of the hot producer gas should be taken into account when calculating the volume of combustion gases. The weight of dry ash-free coke gasified as a percentage on the weight of coal carbonized can be calculated from the following formula:

$$\text{Coke gasified} = C_W \times \left(\frac{100 - W}{100}\right) \times \left(1 - \frac{A}{100 - C_1}\right) \text{ \% by weight on the coal.}$$

where C_W = percentage fuel consumption, *wet* coke, on the weight of coal carbonized.
W = percentage of moisture in the coke.
A = ,, ,, ash in the dry coke.
C_1 = ,, ,, carbon in the producer ashes.

The actual amount of carbon in one pound of dry ash-free coke is, however, less, and can be taken at about 0·96 lb., the difference consisting of H, S, O, and N. The amount of hydrogen can be taken as being about 1% of the weight of carbon. Further reference to this item will be made in the calculation of the volume of producer gas made per pound of carbon.

(*b*) *Producer Gas Reactions.*—The composition of the producer gas depends on the nature of the reactions which take place in the producer. The possible reactions are given below and are based on amorphous carbon.[1]

Molecular Heats of Reactions.

—	Reactions.	Kg. Calories/Kg. Mol.
(1)	$C + O_2 = CO_2$	+ 96,960
(2)	$2C + O_2 = 2CO$	+ 2 × 28,760
(3)	$2CO + O_2 = 2CO_2$	+ 2 × 68,200
(4)	$CO_2 + C = 2CO$	− 2 × 19,720
(5)	H_2O (water) = H_2O (steam)	− 10,575
(6)	$2H_2 + O_2 = 2H_2O$ (steam)	+ 115,640
(7)	$C + H_2O$ (steam) = $CO + H_2$	− 29,060
(8)	$C + 2H_2O$ (steam) = $CO_2 + 2H_2$	− 18,680
(9)	$CO + H_2O$ (steam) = $CO_2 + H_2$	+ 10,380

To convert Kg. Cal/Kg. Mol. to B.Th.U./lb. Mol., multiply by 1·8.

The oxygen-carbon and the steam-carbon reactions, with their various intermediate reactions, are in a definite relation to each other depending on the temperature in the hot zone, the depth of the fuel bed and the time contact between the gases and the fuel. The producer gas equilibrium $\frac{CO \times H_2O}{CO_2 \times H_2} = K$ represents a constant for any given temperature.

Research work by Harris, Clement, &c., indicates that the formation of H_2 requires a longer time contact than is required for the formation of CO.

Tables 1 to 6 in the Appendix and Figures 1 to 12 give Hoffmann's useful data[1] on the Volumetric Constitution of Ideal Producer Gas*. A table of conversion factors from Metric to British units is attached.

Haslam[2] states that the relationship between the apparent equilibrium value and the depth of the fuel bed may be expressed as:

$$K = \frac{CO_2 \times H_2}{CO \times H_2O} = 0{\cdot}096\ L$$

The amount of water vapour in producer gas may be calculated to within 10% by the equation

$$H_2O = \frac{CO_2 \times H_2}{0{\cdot}096\ L \times CO}$$

where H_2O = the volume of total moisture (undecomposed steam *plus* the free and "combined" moisture in the coke) per 100 volumes of dry producer gas,
CO_2, CO, and H_2, = the percentage volumes of the respective constituents as determined by analysis,
L = the depth of fuel bed in ft.

(*c*) *Composition of Producer Gas.*—In general gas-works practice, the producer gas is analyzed for CO_2, O_2, and CO

* Ideal producer gas is a gas resulting from the action of steam and air on carbon and containing only carbon monoxide, carbon dioxide, hydrogen, and nitrogen.

in an Orsat apparatus, the H_2 being determined by calculation. It is found, however, that the CO absorption in an Orsat apparatus is not complete and consequently the calculated H_2 value is higher than the true value. Continuous two-hour samples taken over a period of 24 hours and analyzed by the Orsat and the Hempel methods gave about 2% more CO by the latter method than was determined by the Orsat method.

The correctness of an analysis can be checked by calculation of the nitrogen equivalent of the oxygen contained in the CO_2 and CO less that equivalent to the H_2 since the oxygen is derived either from the air or steam and/or water supplied to the producer. The method is illustrated by means of the following example.

—	Sample A.	Sample B.
	%	%
CO_2	5·0	8·0
CO	30·0	25·0
H_2	11·0	11·0
N_2	54·0	56·0
	100·0	100·0
Oxygen derived from air—	$(5{\cdot}0 + 15{\cdot}0) - 5{\cdot}5 = 14{\cdot}5$	$(8{\cdot}0 + 12{\cdot}5) - 5{\cdot}5 = 15$
Nitrogen equivalentof the oxygen—	$\frac{14{\cdot}5 \times 79}{21} = 54{\cdot}5\%$	$\frac{15 \times 79}{21} = 56{\cdot}4\%$

The calculated figures are thus in good agreement with the determined values.

When samples of Producer Gas are taken, they should preferably be continuous samples collected over a period of a few hours and the temperature of the gas should be measured at the same time. If the moisture content of the gas is also determined, all the figures required for a producer balance are available. A high gasification rate per square foot of grate area generally causes local clinker formation, produces a gas of low calorific value, and increases the fuel consumption per ton of coal carbonized.

(*d*) *Calculation of the volume of Producer Gas obtained per pound of carbon gasified from the analysis of the gas.* —In the following calculations it has been assumed that the actual amount of carbon contained in one pound of dry ash-free coke is 0·96 lb.

All gaseous volumes are on the basis of 0° C., 760 mm., dry.

It is assumed that the composition of the producer gas is that given on the producer gas combustion chart (fig. 13), namely:

CO_2 = 7·0%
CO = 26·0,, Net calorific value
H_2 = 12·0,, = 128 B.Th.U./cu.ft. at 0° C., 760 mm., dry
CH_4 = 0·5,,
N_2 = 54·5,,

The volume occupied by one pound molecule of a perfect gas at 0° C. and 760 mm. is 359·03 cu.ft., *i.e.*, 1 cu.ft. of carbon in gaseous form contains

$$\frac{12}{359{\cdot}03} \text{ or } 0{\cdot}0334 \text{ lb. of carbon.}$$

The above producer gas contains 0·07 + 0·26 + 0·005 = 0·335 cu.ft. of gaseous carbon per cu.ft., *i.e.*, 1 lb. of carbon gasified produced

$$\frac{1}{0{\cdot}0334 \times 0{\cdot}335} \text{ or } 89{\cdot}4 \text{ cu.ft. of producer gas.}$$

On the basis of 14,500 B.Th.U. per lb. as the calorific value of carbon, the cold efficiency of the producer per lb. of carbon charged is, with due allowance for carbon loss in the pan ash (20% carbon in the pan ash with use of coke containing 10% of ash)

$$\frac{89{\cdot}4 \times 128 \times 0{\cdot}972}{14{,}500} \text{ or } 76{\cdot}7\%.$$

With inclusion of the sensible heat of the producer gas at 700° C., the thermal efficiency of the producer is increased from 76·7% to 92%, the latter figure representing the hot efficiency of the producer.

The volume of producer gas per lb. of dry ash-free coke charged will be $89{\cdot}4 \times 0{\cdot}972 \times 0{\cdot}96$, or 83·4 cu.ft.

With 70% decomposition of the steam, the amount of moisture from the 30% of undecomposed steam will be $\frac{3}{7} \times 12$, or approximately 5 cu.ft. per 100 cu.ft. of dry producer gas. The primary air at a temperature of 60° F. and at a saturation of 60% will bring in about 1 cu.ft. of H_2O vapour per 100 cu.ft. of dry air at 0° C. and 760 mm. If the moisture content of the coke is known, the volume of water vapour in the products of combustion can be calculated at any point of the gas flow. A very useful formula for the approximate estimation of the amount of steam supplied to a producer by an orifice nozzle is as follows:

Lbs. of steam per hour per sq.in. of nozzle area = [abs. pressure, lb. sq.in. × 50] + 160.

II. The Process of Combustion.

The volume of theoretical combustion gases per cu.ft. of producer gas of the analysis indicated will be as follows:

Gases from the combustion—	
CO_2	0·335 cu.ft.
H_2O	0·130 ,,
N_2	1·298 ,,
	1·763 ,,
Add undecomposed H_2O	0·050 ,,
Total	1·813 ,,

The total volume of H_2O per 100 cu.ft. of combustion gases when combustion takes place with the theoretical

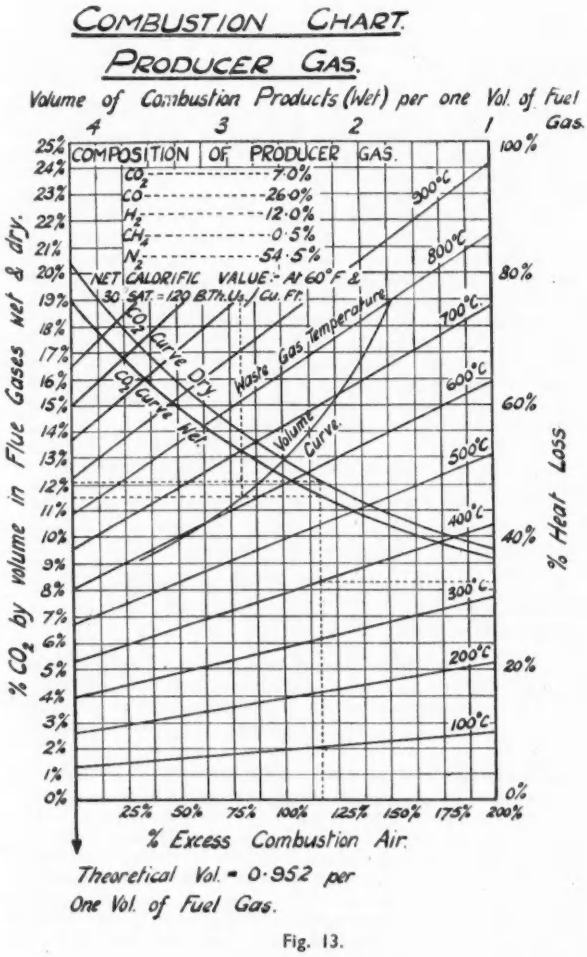


Fig. 13.

amount of air (0·952 cu.ft./cu.ft. of dry producer gas) is equivalent to 11 cu.ft., if the moisture present in the combustion air is included. The theoretical flame temperature when a 20% excess of secondary air is used and the temperatures of preheat of air and gas respectively are 400° C. and 700° C. will be 1,880° C., not allowing for dissociation, or 1,820° C., taking dissociation into account. The flame temperature chart, fig. 14, calculated on the basis of a slightly different analysis for the same conditions of preheat temperatures, but without allowance for moisture vapour in the air or producer gas, gives 1,930° C. Schack's formulæ[3] provide a rapid method for the cal-

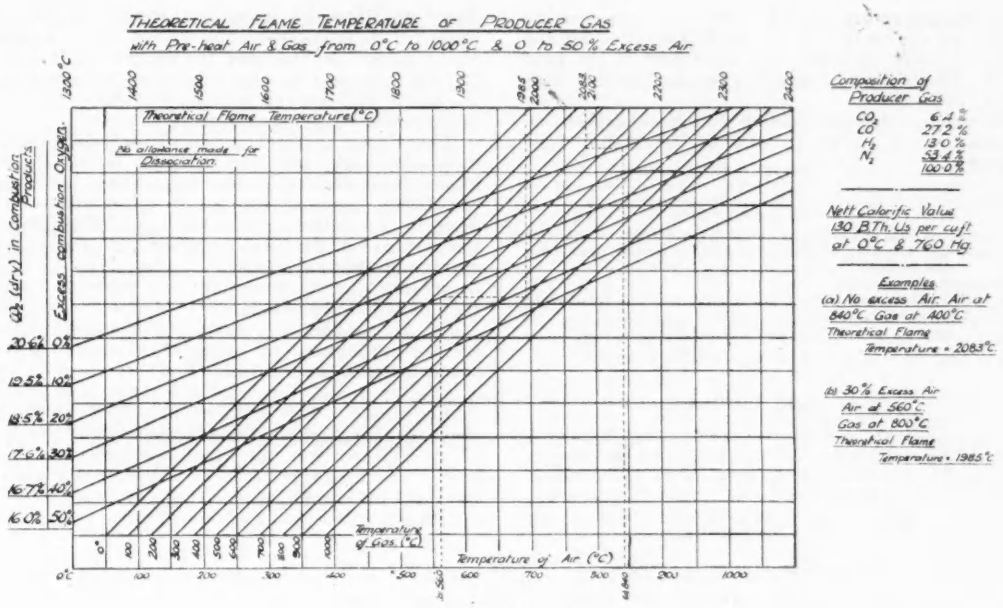

THEORETICAL FLAME TEMPERATURE OF PRODUCER GAS
with Pre-heat Air & Gas from 0°C to 1000°C & 0 to 50% Excess Air
Theoretical Flame Temperature (°C)
No allowance made for Dissociation
Excess combustion Oxygen
CO2 (dry) in Combustion Products
Temperature of Gas (°C)
Temperature of Air (°C)
Composition of Producer Gas
CO2 6.4 %
CO 27.2 %
H2 13.0 %
N2 53.4 %
100.0 %
Nett Calorific Value
130 B.Th.Us per cu.ft.
at 0°C & 760 Mg.
Examples
(a) No excess Air. Air at 840°C. Gas at 400°C.
Theoretical Flame Temperature = 2083°C.
(b) 30% Excess Air
Air at 560°C.
Gas at 800°C.
Theoretical Flame
Temperature = 1985°C.

Fig. 14.

culation of theoretical flame temperatures and do not involve the tedious method of trial and error—

For temperatures between 800° and 1,800° C., theoretical flame temperature

$$= \frac{H_u + Q + 32A + 80B + 75C}{0{\cdot}364A + 0{\cdot}591B + 0{\cdot}477C}$$

For temperatures between 1,100° and 2,400° C., theoretical flame temperature

$$= \frac{H_u + Q + 50{\cdot}4A + 103B + 190C}{0{\cdot}378A + 0{\cdot}607B + 0{\cdot}565C}$$

where H_u = net calorific value of the gas in Kg. cal/m³ dry at 0° C. and 760 mm.
Q = preheat of air and/or fuel gas in Kg. cal. per m³ of fuel gas.
A = volume of $N_2 + O_2$ in the combustion gases in m³ per m³ of fuel gas.
B = volume of CO_2 in the combustion gases in m³/m³ of fuel gas.
C = volume of H_2O in the combustion gases in m³/m³ of fuel gas.
All volumes are at 0° C. and 760 mm.

The formulæ are accurate to within about 1% of the true theoretical flame temperature, without allowance for dissociation.

A simplified method for combustion calculations is provided by Rosin's I.T. Diagram of Combustion[4]. A linear relationship exists between the net calorific value of a fuel and the volume of the theoretical products of combustion, as well as between the net calorific value and the theoretical air requirements. The theoretical basis of these relationships is very simple.

H. Kay[5], in a Paper on Combustion Calculations, gives a very clear account of the use of Rosin's I.T. Diagram, and of Seyler's Fuel Chart. The following is an extract from Kay's Paper:

"The combustion of carbon can be represented by the equation

$$C + O_2 = CO_2$$

that is, 12 lb. of carbon require 359 nft³ of oxygen and yield 359 nft³ of carbon dioxide*. Taking into account the nitrogen in the air, this is equivalent to a combustion gas volume of 142·5 nft³ per lb. of carbon when burnt in air. The calorific value of carbon is 14,400 B.Th.U. per lb., hence the concentration of heat (i) in the products of combustion, at the moment of combustion, is

$$i = \frac{H_u}{V_o} = \frac{14{,}400}{142{\cdot}5} = 101{\cdot}0 \text{ B.Th.U./nft.}^3$$

where H_u represents the calorific value of carbon and V_o the volume of the products of combustion.

Hydrogen, which has a net calorific value of 52,000 B.Th.U. per lb., in combustion in air yields 513 nft³ of combustion gases per lb. The calorific intensity of the products of combustion in this case is

$$i = \frac{H_u}{V_o} = \frac{52{,}000}{513} = 101{\cdot}2 \text{ B.Th.U./nft.}^3$$

Thus, in spite of the great difference in the calorific values of the two fuels, the concentration of heat in the products of combustion in air (that is, their calorific intensity) is practically the same.

Taking a mean value of 101·1 B.Th.U./nft³, we can say

$$i = \frac{H_u}{V_o} = 101{\cdot}1 \text{ B.Th.U./nft.}^3$$

$$\text{or } V = \frac{H_u}{101{\cdot}1} = \frac{9{\cdot}88\ H_u}{1{,}000} \text{ nft.}^3\text{/lb.}$$

Were all fuels composed solely of carbon and hydrogen the application of this fundamental equation would be rigorous. Oils, in general, approach this ideal, and with them the equation derived from the statistical graph already shown is

$$V_o = \frac{9{\cdot}87\ H_u}{1{,}000} \text{ nft}^3\text{/lb.}"$$

Dissociation does not affect the general heating of gas retorts as the temperature of the gases leaving the heating flues is well below 1,500° C., and therefore any dissociated gases will have recombined. Actually, dissociation (which increases with increase in the content of water vapour) tends to give longer flame conditions.

As shown by Rosin's work, net calorific values should be used as a basis for thermal calculations. Further, it is preferable and less complicated to base all volumes on N.T.P. conditions, *i.e.*, 0° C., 760 mm., dry. Table 8 gives the mean specific heats of the constituents of combustion gases measured at 0° C. and 760 mm. in B.Th.U. per 1,000 cu.ft. per ° F.

The specific heats of H_2 and CH_4, as well as general data covering the properties of gases concerned in the combustion of fuels, can be found in "Technical Data on Fuel" edited by H. M. Spiers.

III. Heat Requirements for Carbonization.

In static retorts and in coke ovens, the amount of heat actually transmitted through the heating flues is found to be approximately 700 B.Th.U. per lb. of coal, assuming that the coke is discharged at about 1,000° C. In continuous vertical retorts, the heat supplied to the charge is rather less and varies according to the percentage of steaming. In the case of static carbonization without steaming, the actual amount of heat transmitted can be calculated from the sensible heat content of the products of carbonization leaving the retorts, with due allowance for the endothermicity or exothermicity of the carbonizing process.

Terres and Schaller[6] give the following value for the mean specific heat of coke between 21° C. and 1,000° C., A denoting the percentage of ash present in the coke.

$$0{\cdot}382 - 0{\cdot}00135A \text{ Kg. cal./kg./° C.}$$

For the tar and benzole vapour, allow 5 B.Th.U./lb. of coal per 100° C.

The sensible heat in the gas and water-vapour are to be calculated from specific heat tables.

Continuous vertical retorts when operated with a high percentage of steaming will obviously call for an increased fuel consumption, but the extra amount of heat trans-

* 1 lb. molecule of a perfect gas occupies 359 nft.³ at 0° C. and 760 mm.

mitted through the retort walls for the water-gas reaction will be less than the 75 B.Th.U. normally required for the production of 1 cu.ft. of water-gas, since part of the heat required for the reaction is supplied by the sensible heat of the coke.

The time required for carbonizing a static charge to an end temperature of 1,000° C. can be calculated from Terres' formula.[7]

$$\text{Carbonizing time} = \frac{a \times b \times c}{k \times 10 \times t_m \times 3{,}600} \text{ hours.}$$

where a = coking heat at 1,000° C. (300–400 Kg. cal./kg.)
b = weight of coal in a volume formed of one sq.m. of the oven wall and half the oven width (kg.)
c = half of oven width in cm.
k = thermal conductivity of the charge over the carbonizing range (C.G.S. units) = 0·003 to 0·0032 C.G.S. units for carbonization to 1,000° C.

t_m = mean carbonizing temperature = $\frac{1{,}000}{2}$ = 500° C.

IV. Surplus Heat Utilization.

The combustion gases must leave the heating flues at a temperature higher than that at which the coking process takes place. This temperature may be taken to be about 1,100° C. for a coking temperature of 1,000° C. inside the retort for static charges, and about 1,000°-1,050° C. for continuous retorts. The heat available in these gases (surplus heat) can be utilized for partial or maximum preheating of the combustion air or, when cold producer gas is used, for the preheating of the air and gas, or this surplus heat can be used for the generation of steam in waste heat boilers. The decision should be in favour of the alternative which yields the best results in heat economy from a commercial point of view. It is obvious that refractory heat interchangers give a much lower efficiency than waste heat boilers, on account of greater air infiltration and radiation losses. It has been found that the combined thermal efficiency of the carbonizing plant and waste heat boiler is higher for non-recuperative settings with maximum waste heat recovery in waste heat boilers than with partial recuperation and steam recovery or with maximum regeneration without steam production.

V. Waste-Heat Boilers.

Steam generation in waste heat boilers has to-day become standard practice, hence the Author will confine this section to a few general remarks concerning recent improvements and to a few technical notes on the basis of the calculation of steam recovery, heat transfer, and pressure loss through the boiler tubes.

To meet a condition which may exist in a number of works, namely, one in which the amount of steam generated by waste heat is insufficient for the constant or peak requirements, a system has been evolved for augmenting the heat available in the waste gases by introducing producer gas into the waste gas stream and in most cases using for its combustion the oxygen always present in the waste gases. In this way the amount of steam generated can be increased to the maximum steaming capacity of the boiler without any increase of labour. The gas is thus burnt under ideal conditions.

Where local requirements demand a high degree of augmentation and where the resultant temperature would be higher than desirable, the temperature is reduced by recirculating part of the waste gases from the induced draught fan outlet back to the point of combustion. The temperature of the mixed combustion gases is lowered and maximum thermal efficiency is maintained. The increase of volume due to recirculation is only very slightly over that met with when cold air is used as the diluent.

Fig. 15 enables the amount of producer coke required for the production, by augmentation, of a given amount of steam to be determined. For this purpose, use is made of the top scale, the left-hand scale, and the unmarked sloping line. The diagram also enables the weight of steam produced per pound of coke supplied to a setting to be ascertained from the known temperature and CO_2 content of the waste gases. For this purpose, use is made of the right-hand and bottom scales in conjunction with the sloping lines indicating CO_2 contents.

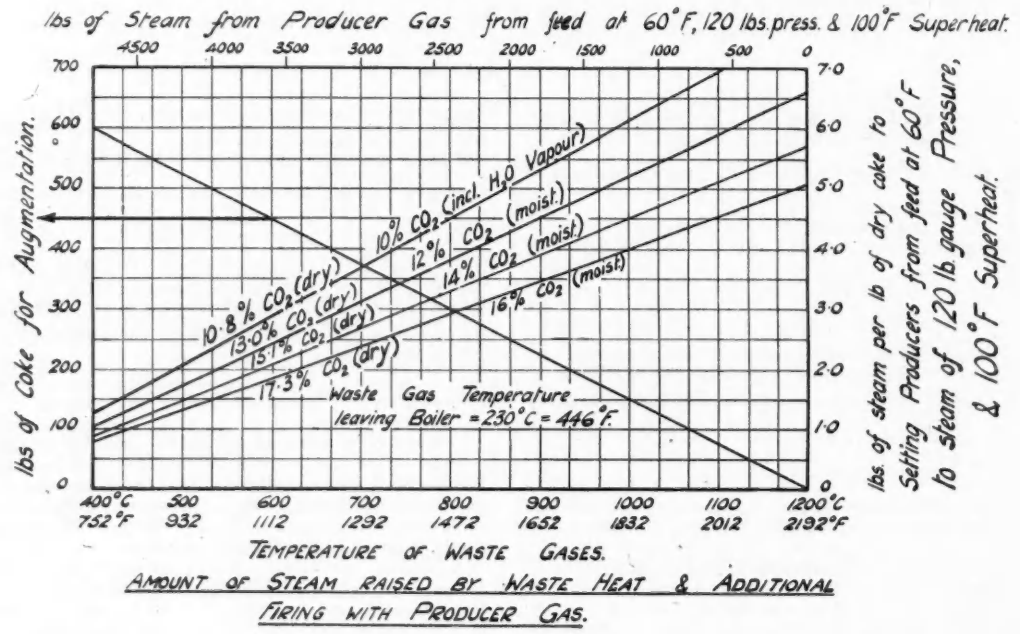

lbs of Steam from Producer Gas from feed at 60°F, 120 lbs.press. & 100°F Superheat.
4500 4000 3500 3000 2500 2000 1500 1000 500 0
700 600 500 400 300 200 100 0
lbs of Coke for Augmentation.
7·0 6·0 5·0 4·0 3·0 2·0 1·0 0
lbs. of steam per lb of dry coke to Setting Producers from feed at 60°F to steam of 120 lb gauge Pressure, & 100°F Superheat.
10·8 % CO2 (dry)
13·0 % CO2 (dry)
15·7 % CO2 (dry)
17·3 % CO2 (dry)
10% CO2 (incl. H2O Vapour)
12% CO2 (moist.)
14% CO2 (moist.)
16% CO2 (moist.)
Waste Gas Temperature leaving Boiler = 230°C = 446°F.
400°C 500 600 700 800 900 1000 1100 1200°C
752°F 932 1112 1292 1472 1652 1832 2012 2192°F
TEMPERATURE OF WASTE GASES.
AMOUNT OF STEAM RAISED BY WASTE HEAT & ADDITIONAL FIRING WITH PRODUCER GAS.

Fig. 15.

The following example illustrates a method of determining the amount of steam which can be generated from the waste gases of a carbonizing plant. The working conditions are assumed to be as follows:

Fuel consumption (dry coke) per 100 lb. of coal carbonized	15 lb.
Percentage of carbon gasified on the weight of dry coke	85%
CO_2 content of the moist waste gases	13%
Temperature of the waste gases—	
(*a*) Entering boiler	1,432° F.
(*b*) Leaving boiler	432° F.

To calculate the available heat content of the waste gases, it is first necessary to determine their volume. As has already been stated, the molecular weight of a perfect gas expressed in grammes occupies 22·412 litres at 0° C. and 760 mm. The equivalent volume in British units is 359·03 cu.ft. per pound-molecule at 0° C. and 760 mm. (N.T.P.). For approximate calculations 360 cu.ft. per pound-molecule will be sufficiently accurate. In the present example, the moist waste gases contain 13% of CO_2, equivalent to 0·0333 × 0·13 lb. of carbon per cu.ft. The volume of cold waste gases per ton of coal carbonized will be as follows:

$$\frac{2{,}240 \times 0{\cdot}15 \times 0{\cdot}85}{0{\cdot}0333 \times 0{\cdot}13} = 65{,}970, \text{ or say, } 66{,}000 \text{ cu.ft.}$$

The mean specific heats of the waste gases between 32° F. and boiler inlet and outlet temperatures have been

calculated from the mean specific heats in Table 8 and are as follows:

Between 32 and 1,432° F.:—22 B.Th.U. per 1,000 cu.ft. per ° F.
Between 32 and 432° F.:—20·9 ,, ,, ,, ,, ,, ,,

Sensible heat content above 32° F. of the waste gases—

(*a*) Entering the boiler = 66 × 22 × 1.400 . .	2,032,800 B.Th.U.	..	100·0%
(*b*) Leaving the boiler = 66 × 20·9 × 400 . .	551,760 ,,	..	27·1 ,,
Amount of heat taken up by the water and lost in radiation . .	1,481,040 ,,	..	72·9 ,,
Radiation loss (estimated) . . .	70,040 ,,	..	3·4 ,,
Heat taken up by boiler	1,411,000 ,,	..	69·5 ,,

The equivalent steam production from and at 212° F. is thus—

$$\frac{1{,}411{,}000}{970{\cdot}4} \text{ or } 1{,}450 \text{ lb. per ton of coal carbonized.}$$

The log log formula, given below, of Lawford H. Fry[5] for the determination of tube length for given diameters and velocities has been found to be in close agreement with results from actual practice.

$$\log\log\frac{T_1}{t} - \log\log\frac{T_2}{t} = ML \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{where } \log M = B - m.\log\frac{w}{p} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\log(1{\cdot}3 + B) = \bar{1}{\cdot}71 - 0{\cdot}54\log d \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$\log m = \bar{1}{\cdot}36 + 0{\cdot}37\log d \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

L = length along tube (ft.).
w = mass flow of gas (lb. per hr. per tube).
d = internal diameter of tube (in.).
p = internal perimeter of tube (in.).
T_1 = gas inlet temperature
T_2 = gas temperature at L ft. } ° F. absolute.
t = flue wall temperature }

The pressure loss through the tubes can be calculated from the following formula[6]:

$$\text{Pressure drop} = \frac{13 \times W_o^{1{\cdot}852} \times \frac{T}{273\ P} \times L}{10^4 \times d^{1{\cdot}269}} \text{ mm. W.G.}$$

Where P = pressure in atmos. (1 Atm. = 760 mm. Hg.)
W_o = velocity of gas at 0° C. and 760 mm. in metres/sec.
T = mean temperature of gas in ° C. absolute.
L = length in m.

The detrimental effect of air infiltration can be determined from the producer gas chart (fig. 13).

When temperatures and samples of waste gases are required for the purpose of a heat balance calculation, the two should be taken at the same spot and at the same time. Special care is to be taken not to place the thermocouple near the tube-plate of the waste heat boiler or the temperature measured will be very much lower than the actual one. The couple should be inserted into the brick flue well before the boiler inlet. If the fan is steam driven and the exhaust steam is used for feed water heating, the amount of heat imparted to the feed can be added to the heat of the waste gases utilized for steam raising. The amount of steam generated is then calculated "from and at" the temperature of the feed water entering the exhaust-steam heater.

VI. Heat Balances.

The preparation of a heat balance normally involves a considerable amount of work and cost.

A fair degree of accuracy is obtainable if the heat balance is built up from the net calorific value of the fuel expressed on a weight or volume basis according as the fuel is solid or gaseous. The Author has applied this method over a considerable number of years and has found it extremely reliable. In the heat balance of an upwardly heated vertical retort setting, shown by a slide, the distribution of the heat has been based on the fuel required per pound of coal carbonized. Rosin and Fehling have simplified the method of calculation still further, as indicated in a previous section.

In general, it can be stated that the heat released at the point of combustion and the heat absorbed in the carbonizing process are, for a given design and for similar operating conditions, practically constant. This is illustrated by the following two examples:

Type of Setting.	Full Regeneration to Air and Gas.	Non-Recuperative.
1. Producer gas	Clean, cold gas reheated	Temperature about 800° C.
2. Heat input to producer/lb. coal .	1,440 B.Th U.	1,640 B.Th.U.
3. Heat in producer gas to setting . .	1,090 ,,	1,440 ,,
4. Sensible heat in secondary air (and gas)	462 ,,	114 ,,
5. Heat supplied to combustion flues .	1,552 ,,	1,584 ,,
6. Heat used in carbonization process and radiation losses	892 ,,	508 ,,
7. Heat returned for recuperation . .	462 ,,	144 ,,
8. Heat to waste-heat boiler . . .	..	932 ,,
9. Heat absorbed by waste-heat boiler	..	734 ,,
10. Heat to chimney	198 ,,	198 ,,
Item 3, *plus* item 4, = item 5 . . .	1 552 ,,	1,584 ,,

i.e., the total input of potential and sensible heat into the combustion zone is, for a given type of carbonizing plant, practically a constant whether the setting is of the regenerative or non-recuperative type.

VII. Chimney Calculations.

The resistance to the flow of gases through a chimney follows the same laws as does the flow of gases through ducts or flues, *i.e.*, the pressure drop due to friction and to the loss of velocity head is identical in the two cases.

The theoretical pressure difference between a column of hot gases inside the chimney and a column of atmospheric air of equal height represents the theoretical draught of the chimney.

The actual available draught is the theoretical amount less the pressure drop due to friction and loss of velocity head indicated above.

The following formula gives information regarding the relationship of height, diameter, and available draught for any flue gas temperature and atmospheric temperature.

$$h = \left[H\,(\rho_a - \rho_w) - \left(1 + 0{\cdot}09\,\frac{H}{D}\right)\frac{v^2\rho_w}{2g}\right] \div A$$

—	Metric Units.	British Units.
h = available draught at chimney base.	mm. water-gauge	inches water-gauge
H = height of chimney . . .	metres	feet
D = internal diameter of chimney at top	metres	feet
ρ_a = density of air at atmospheric temperature . .	kilogrammes/m³	pounds/cu.ft.
ρ_w = density of the chimney gas at mean temperature in chimney	kilogrammes/m³	pounds/cu.ft.
v = velocity of gas in chimney corresponding with density ρ_w	metres/second	feet/second
g = acceleration due to gravity.	9·815 metres/sec.²	32·2 ft./sec.²
A = a constant having the value	1	5·2

The Author wishes to express his thanks to his Chief, Dr. E. W. Smith, and to the other Directors of the Woodall-Duckham Companies for permission to present this Paper.

APPENDIX.

TABLE 1.

[Mutual relationship of the four constituents of the ideal gas formed from carbon, air, and water vapour.]

In the case of a gas consisting of CO, H_2, CO_2, and N_2 and derived from the action of steam and air on carbon, when the percentages of any two constituents of the gas are known, the percentages of the other two constituents can be calculated by use of the formulæ given in the table.

—	—	Known.	To be Calculated.	Formula.
I.	a	CO_2 and CO	H_2 =	+ 5·401 CO_2 + 3·267 CO − 113·37
	b		N_2 =	− 6·401 CO_2 − 4·267 CO + 213·37
II.	a	CO_2 and H_2	CO =	− 1·6530 CO_2 + 0·3061 H_2 + 34·70
	b		N_2 =	+ 0·6530 CO_2 − 1·3061 H_2 + 65·30
III.	a	CO_2 and N_2	CO =	− 1·500 CO_2 − 0·2344 N_2 + 50·00
	b		H_2 =	+ 0·500 CO_2 − 0·7656 N_2 + 50·00
IV.	a	CO and H_2	CO_2 =	− 0·6049 CO + 0·1852 H_2 + 20·99
	b		N_2 =	− 0·3951 CO − 1·1852 H_2 + 79·01
V.	a	CO and N_2	CO_2 =	− 0·6667 CO − 0·1562 N_2 + 33·33
	b		H_2 =	− 0·3333 CO − 0·8438 N_2 + 66·67
VI.	a	H_2 and N_2	CO_2 =	+ 2·000 H_2 + 1·531 N_2 − 100·00
	b		CO =	− 3·000 H_2 − 2·531 N_2 + 200·00

Table 2.

[Constants for the complete construction of the field of co-ordinates (Figs. 1 and 2).]

I. *Boundary Points.*

Point A = 0·00 CO, 0·00 H_2; Point B = 34·70 CO, 0·00 H_2.
Point C = 50·00 CO, 50·00 H_2; Point D = 0·00 CO, 66·67 H_2.

II. *CO_2 Co-ordinates.*

On AB . Point (1) = 18·17 CO; Point (2) = 1·64 CO.
On AD . Point (3) = 48·66 H_2.
On CD . Point (4) = 35·00 CO; Point (5) = 20·00 CO; Point (6) = 5·00 CO.

III. *H_2 Co-ordinates.*

On CB . Point (7) = 42·34 H_2; Point (8) = 34·69 H_2; Point (9) = 27·03 H_2; Point (10) = 19·38 H_2; Point (11) = 11·72 H_2; Point (12) = 4·06 H_2.
On BA . Point (13) = 22·83 CO.
On DA . Point (14) = 58·23 H_2; Point (15) = 49·79 H_2; Point (16) = 41·35 H_2; Point (17) = 32·92 H_2; Point (18) = 24·48 H_2; Point (19) = 16·04 H_2; Point (20) = 7·60 H_2.

Table 3.

[Quantities of materials involved in the formation of the gases corresponding to the boundary points of the field A B C D.]

Gas Composition.	Kg. of Carbon/ M^3 of Gas.	M^3 of Gas/Kg. of Carbon.	Kg. of H_2O Decomposed/M^3 of Gas.	Kg. of H_2O Decomposed/Kg. of Carbon.
	(Fig. 4.)	(Fig. 5.)	(Fig. 6.)	(Fig. 7.)
Point A (= 20·99 CO_2 + 79·01 N_2)	0·1124	8·900	0	0
Point B (= 34·70 CO + 65·30 N_2)	0·1858	5·383	0	0
Point C (= 50·00 CO + 50·00 H_2)	0·2677	3·736	0·4018	1·501
Point D (= 33·33 CO_2 + 66·67 H_2)	0·1785	5·604	0·5358	3·003

Table 4.

A.—Heats of formation of CO and CO_2 in kg. cal. per kg. molecule.

(*a*) C + O_2 = CO_2 + 96,960 kg. cal.
(*b*) C + ½O_2 = CO + 28,760 ,,
(*c*) C + H_2O (steam) = CO + H_2 − 29,060 ,,
(*d*) C + 2H_2O (steam) = CO_2 + 2H_2 − 18,680 ,,

B.—Heats of formation of CO_2, CO, and water gas (0° C., 760 mm.).

(*a*) 1 m^3 CO_2 (from C + O_2) = + 4,326 kg. cal.
(*b*) 1 m^3 CO (,, C + ½O_2) = + 1,283 ,,
(*c*) 1 m^3 CO + 1 m^3 H_2 (,, C + H_2O steam) = − 1,297 ,,
(*d*) 1 m^3 CO_2 + 2 m^3 H_2 (,, C + 2H_2O steam) = − 833·5 ,,

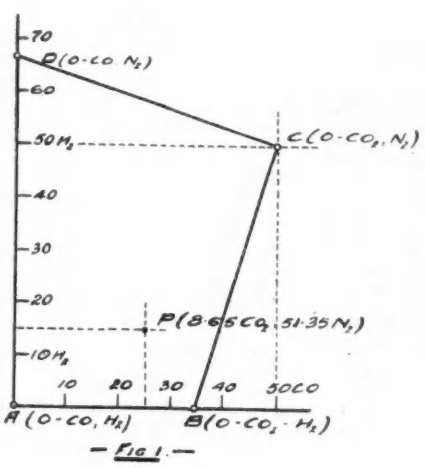
C.—Heats of formation of the boundary gases (0° C., 760 mm.) kg. cal./m^3.

(*a*) 1 m^3 gas A (20·99 CO_2 + 79·01 N_2) = + 908·1 kg. cal.
(*b*) 1 m^3 gas B (34·70 CO + 65·30 N_2) = + 445·3 ,,
(*c*) 1 m^3 gas C (50·00 CO + 50·00 H_2) = − 648·5 ,,
(*d*) 1 m^3 gas D (33·33 CO_2 + 66·67 H_2) = − 277·8 ,,

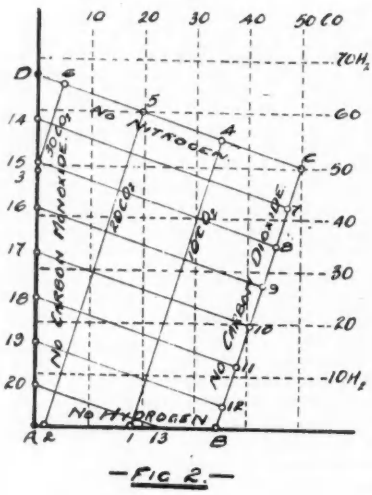
Table 5.

[Heats of Formation and Calorific Values of the Gases Corresponding to the Boundary Points and to Other Points of the Field A B C D and the Corresponding Thermal Efficiency of their Production.]

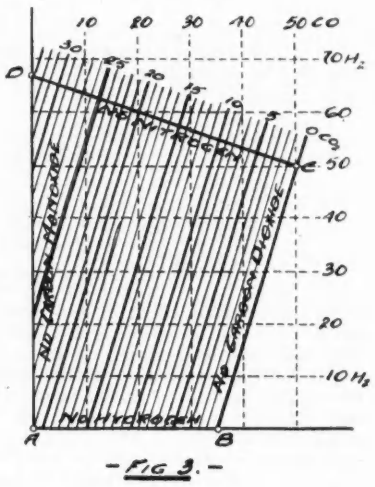
—	Heat of Formation of the Gas in Kg. Cal. per M^3.	Net Calorific Value of the Gas in Kg. Cal. per M^3.	Theoretical Cold Thermal Efficiency of the Producer, %.
	(Fig. 8.)	(Fig. 9.)	(Fig. 10.)
Point A (20·99 CO_2, 79·01 N_2)	908·1	0	0
Point B (34·70 CO, 65·30 N_2)	445·3	1,056	70·35
Point C (50·00 CO, 50·00 H_2)	−648·5	2,811	130·0
Point D (33·33 CO_2, 66·67 H_2)	−278	1,720	119·3
Point M_1 (40·93 CO, 20·35 H_2, 38·72 N_2)	0	1,769	100·0
Point M_2 (30·44 CO_2, 51·04 H_2, 18·52 N_2)	0	1,316	100·0



— Fig 1. —



— Fig 2. —



— Fig 3. —

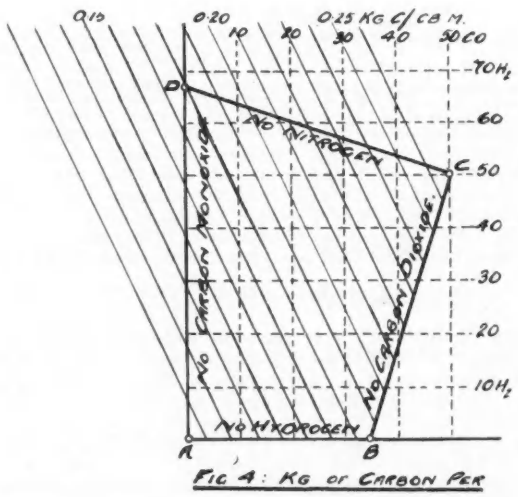


Fig 4: Kg of Carbon per 1 cb m of Gas.

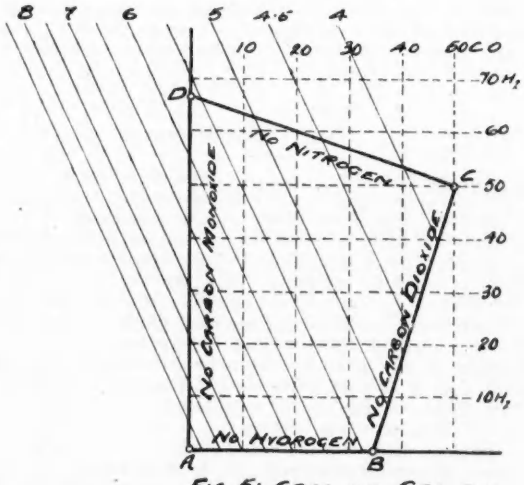


Fig 5: cbm of Gas per Kg of Carbon.

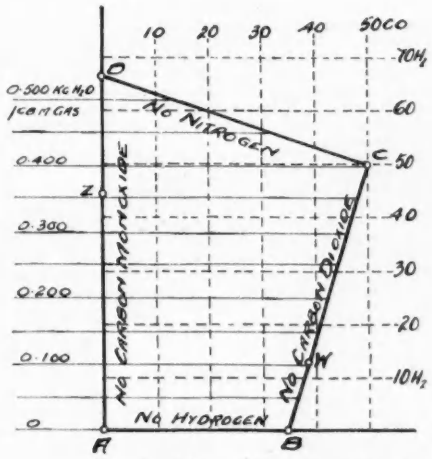


FIG 6: KG OF H_2O DECOMPOSED PER 1 CB M OF GAS

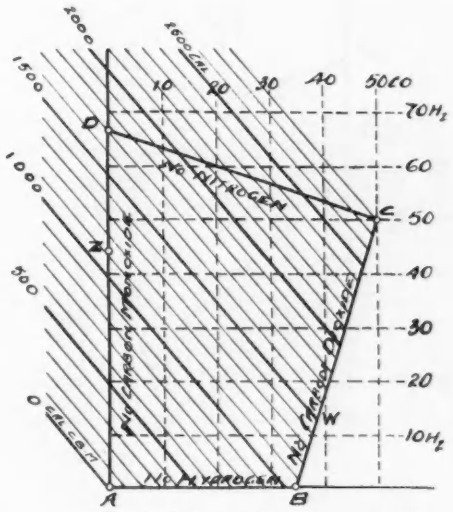


FIG 9: NETT CALORIFIC VALUE PER CB M OF GAS

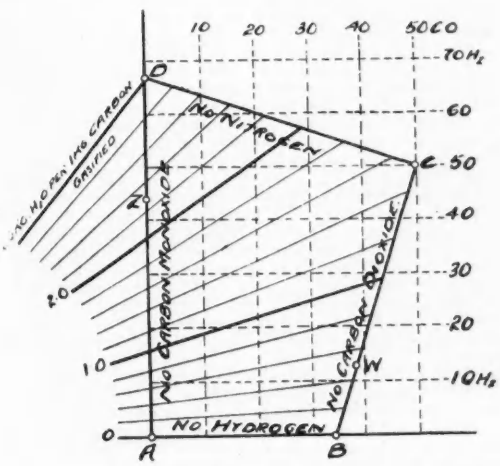


FIG 7: KG OF H_2O DECOMPOSED PER 1 KG OF C GASIFIED.

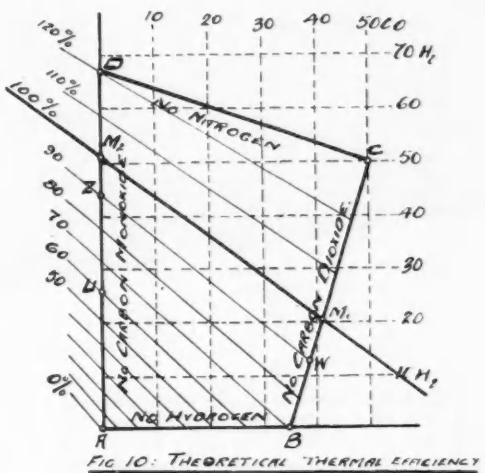


FIG 10: THEORETICAL THERMAL EFFICIENCY BASED ON THE COMPOSITION OF THE GAS.

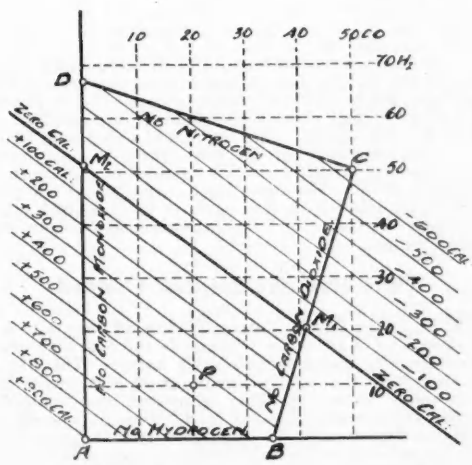


FIG 8: ISOTHERMS OF THE HEAT OF FORMATION PER CB M OF GAS

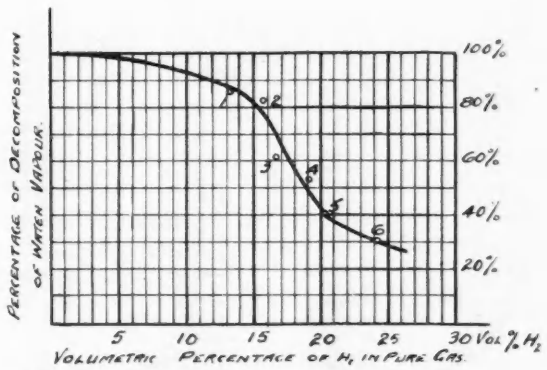


FIG 11: RELATIONSHIP OF H_2 CONTENT AND DEGREE OF DECOMPOSITION IN MOND PRODUCER PRACTICE (SEE TABLE VI).

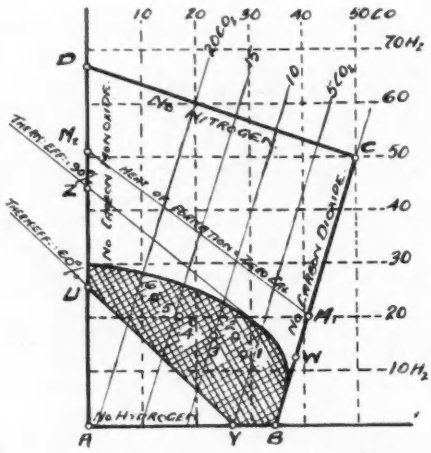


FIG 12. PRODUCER GAS AREA.

TABLE 6.

[Smoothed Values for the Degree of Decomposition of Water Vapour in the Producer Based on the Tests of Bone and Wheeler on a Mond Producer Plant. (Figures 11 and 12.)]

Calculated H_2 content of the gas	5	10	11	12	13	14	15	16
% H_2O decomposed	97·5	93·5	92·0	90·5	88·5	86	83	77

Calculated H_2 content of the gas	17	18	19	20	21	22	23	24	25
% H_2O decomposed	68	58·5	48·5	42	38	35·5	32·5	30·5	29

TABLE 7.

CONVERSION FACTORS.

Table 4.—	Kg. of carbon/m^3	× 0·06243	= lb. of carbon/cu.ft.
,, 4.—	M^3/kg. of carbon	×16	= cu ft. lb. of carbon
,, 5.—(A)	Kg. cal./kg. mol.	× 1·8	= B.Th.U./lb. mol.
,, 5.—(B)	Kg. cal./m^3	× 0·1124	= B.Th.U./cu.ft.
,, 6.—	Kg. cal./m^3	× 0·1124	= B.Th.U./cu.ft.

TABLE 8.

[Mean specific heat of gases at constant pressure between 32° F. and *t*° F. (B.Th.U. per 1,000 cu.ft. per 0° F. for the gas measured at 0° C. and 760 mm.)][10]

t, ° F.	Carbon Dioxide, CO_2.	Water Vapour, H_2O.	Oxygen Nitrogen, Air, Carbon Monoxide.
32	24·729	23·172	19·435
212	25·539	23·234	19·559
392	26·535	23·359	19·684
572	27·532	23·421	19·808
752	28·404	23·546	19·933
932	29·089	23·725	20·057
1,112	29·712	23·857	20·182
1,292	30·335	23·982	20·307
1,472	30·958	24·231	20·431
1,652	31·456	24·542	20·556
1,832	31·830	24·791	20·680
2,012	32·204	25·041	20·805
2,192	32·453	25·352	20·929
2,372	32·765	25·726	21·054
2,552	33·014	26·037	21·179
2,732	33·388	26·411	21·303
2,912	33·699	26·785	21·428
3,092	34·010	27·283	21·552
3,272	34·259	27·781	21·677
3,452	34·509	28·342	21·802
3,632	34·633	28·965	21·926
3,812	34·758	29·588	22·051
3,992	35·007	30·211	22·175
4,172	35·256	30·834	22·300
4,352	35·381	31·456	22·424
4,532	35·505	32·142	22·549
4,712	35·630	32·827	22·674
4,892	35·755	33·512	22·798
5,072	35·941	34·197	22·923
5,252	36·066	34·945	23·047
5,432	36·190	35·692	23·172

EXAMPLE.—The amount of heat required to raise 1,000 cu.ft. of CO_2 from 32° F. to 212° F. would be (212 − 32) × 25·539 = 4,597 B.Th.U.

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Discussion.

Mr. G. DOUGILL (Gas Light and Coke) said that the many formulæ and the data supplied in the tables, all in normal gas-works units, should prove very useful. There were, however, one or two matters he would like to raise with the Author, the first being with regard to the units employed. He noticed Mr. Reber used the lb.-molecule, but as there were 28·3 gms. in 1 oz. and 28·3 litres in a cu.ft., an oz.-molecule of gas occupied 22·24 cu.ft. at 0 and 760, or approximately 24 cu.ft. at 60° F., 30 in. mercury and saturated. This meant that all figures for gm.-molecules and litres could be used for oz.-molecules and cu.ft. As most technical workers had to use both the metric and the English systems almost indiscriminately, factors common to both were very acceptable.

He noticed Mr. Reber mentioned analyses of hot producer gas, and Mr. Dougill asked if he had any methods to suggest for improving the sampling of these. In the past it had not been unknown for samples to be taken through iron tubes, though there was no excuse for this now that fused silica tubes were available. They usually used 1 or 2 mm. bore thick-walled fused silica capillary tubes and drew the gas away at high velocity. Under these conditions was there any possibility that the water gas equilibrium would shift during the passage of the gas through the hot parts of the tube, and so give a misleading analysis?

At the beginning of the section dealing with heat requirements for carbonization, a statement was made that 700 B.Th.U. was required to pass through the retort wall per lb. of coal. Knowing the temperature drop across the retort wall and the area exposed per lb. of coal, could Mr. Reber say if the conductivity calculated in this way agreed with the known value for silica? The problem was complicated by the area of retort wall covered by supporting walls, but formulæ for dealing approximately with the heat flow through these could be developed.

Continuing, Mr. Dougill observed that Mr. Reber made out a good case for the overall efficiency of the non-recuperative setting with waste-heat boiler. In the coke oven plant at Beckton, which might be taken as a good example of the efficient recuperative setting without waste-heat boiler, Mr. R. W. Hunter, in his Paper to The Institution of Gas Engineers in 1933, showed that the waste gases were cooled to 230° C. at the main flue, and under 10% of dry ash-free coke was consumed. A rough check of this figure showed it to be similar to the fuel consumption given by Mr. Reber after deducting the heat in the steam generated. This recuperative setting, therefore, allowed the steam to be generated separately, and independently of the carbonizing unit without any sacrifice of efficiency—under many conditions a very valuable consideration.

One further question he would like to ask was whether Mr. Reber could give any practical suggestions for taking the waste-gas temperatures at the inlet to the waste-heat boilers. The precaution he mentioned of placing the pyrometer away from the face of the waste-heat boiler was, of course, vital; but there was still the question of lack of mixing of the waste gases from the various settings, and in some cases where the flue was short and led from the centre of the main flue under the settings, the problem appeared insoluble. Any experiences of Mr. Reber in this connection would be appreciated.

Mr. C. W. M. ROGERS (Gas Light and Coke) said he had in mind to apply some of Mr. Reber's figures to their own independent producer plant, in which connection the depth of the clinker entered into the calculations. He asked whether Mr. Reber's figure relative to the depth of the fuel bed coke zone was inclusive of clinker. He also enquired as to the amount of carbon in the pan ash.

Only Half the Sulphur Gasified.

Mr. R. F. TWIST (South Metropolitan) paid tribute to a Paper which should be of great use to those in the Industry who were not familiar with calculations of this nature. The Paper was so comprehensive that any comments must of necessity be confined to small matters. When allowance was made for the sulphur in coke in producer gas calculations, it was important, if accuracy was desired, to remember two things—first, that only about one-half of the sulphur in the coke was gasified, the other half being left in the ash; secondly, that the presence of hydrogen sulphide in producer gas was not usually recognized, as it was absorbed in the caustic potash solution and reported as CO_2. This did a slight injustice to the producer gas, since

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H_2S was a combustible gas and contributed to the potential heat of the gas to the extent of approximately 1%.

In determining the carbon content of clinker from a producer, said Mr. Twist, any method based on the taking of increments was most unreliable. One of the few ways in which a satisfactory sample for analysis might be obtained was to crush the whole of the clinker from the producer down to less than 1 in. This might be done conveniently in the pan mill commonly used on gas-works for preparing fireclay; the crushed clinker might then be sampled by taking several increments.

The Author mentioned that the heat of carbonization was accounted for by the heat carried away by the coke, gas, &c., which reminded Mr. Twist of a small but interesting refinement which was included in this item by one enthusiast, who pointed out that work was done by the gas leaving the coal, in pushing back the atmosphere. This work could be expressed in terms of heat, but as it amounted to only 15-20 B.Th.U. out of a total of, say, 700 B.Th.U. needed for the carbonization of 1 lb. of coal, it was hardly worth taking into consideration.

Continuing, Mr. Twist said he was very pleased to see that Mr. Reber had dealt with chimney calculations, because it was a subject on which a great deal of ignorance existed. In one of the best books on gas-works practice, the rule was given that the constructional area of the chimney should be so many square feet per linear foot run of retort, and it could be shown in certain cases that a chimney constructed to this rule might have twice the area necessary and thus might be needlessly expensive. He would, however, like to tilt at the formula which Mr. Reber had given—not on theoretical grounds, because he realized it was fundamentally correct, but on the grounds of its application. The formula involved knowledge of the density of the gas at the mean temperature in the chimney, but all they could usually know was the temperature and composition and therefore the density of the gas at the *base* of the chimney. If the chimney was built of brick, and developed a few cracks, air was pulled in and altered both the composition and temperature of the gas, and unless they were prepared to climb to the top of the chimney—or, better still, persuade someone else to do so—and take samples and temperatures, they could not know the true mean conditions.

One further small point which was probably of interest to research workers only—the calorific value of carbon depended upon its physical state; the calorific value for amorphous carbon was 14,540 B.Th.U. per lb., and this figure was taken for most calculations, but the heats of reaction for a large number of reactions were given in *Technical Data on Fuel* with reference to β graphite, the heat of combustion of which was appreciably less than 14,540 B.Th.U. per lb.—he forgot the exact figure at the moment. Could Mr. Reber state the form in which carbon was present in coke which had been heated to 1,000° C., since this was the form of carbon with which they were frequently concerned?

Mr. T. G. Noble (Gas Light and Coke) referred to Mr. Masterman's attempts to define a fundamental value for the chimney pull in respect to flues for gas-fired appliances; but they had some difficulty in determining the flue temperature. In endeavouring to get some form of calculation as to heat losses, Mr. Masterman arrived at a formula based on the assumption that the heat loss was roughly proportional to the area of the flue. Mr. Noble observed that in any domestic chimney they ultimately came up against the effect of wind, for which they could not make any definite allowance. He wondered whether Mr. Reber's formula made allowance for this factor.

The Author's Reply.

In reply to Mr. Dougill, Mr. Reber stated that though he was familiar with the similarity between values expressed in terms of ounce- and gramme- molecules, he preferred to work in pound-molecules. As regards the sampling of hot producer gas, he felt that the use of fused silica tubes should give results accurate enough for all practical purposes though recent Continental practice was in favour of the use of water-cooled sampling tubes. He pointed out that the figure of 700 B.Th.U. per pound of coal quoted as the heat transfer across the retort walls was given merely by way of illustration and that the question of the heating surface required was one rather of design than of the actual conductivity of the bricks since the thermal conductivity of bricks was not a constant characteristic but varied with the age of the bricks and was affected by deposition of carbon within the pores. He agreed that a modern coke oven plant had a very high thermal efficiency though he was of the opinion that, even with a fuel consumption much smaller than 10% of dry ash-free coke, the total fuel consumed for carbonization and for the generation of the steam, otherwise raised from the surplus heat of a non-recuperative setting, in a separate fuel-fired boiler would considerably exceed the fuel consumption of a non-recuperative setting. Moreover, it was practically impossible to adopt, in a small gas-works, the same methods for ensuring a maximum thermal efficiency as could be used in a large works such as Beckton.

The only methods he could suggest for overcoming the difficulties in the accurate measurement of the temperature of the waste gas at the boiler inlet due to bad mixing or stratification consisted in the insertion of a certain amount of chequer work in the waste gas flue or in the use of a suction pyrometer.

In connection with Mr. Rogers' question, the Author stated that the overall depth of the fuel bed, including clinker, was to be used in connection with the formula. The amount of carbon in the pan ash increased with increase in the ash content of the coke.

In reply to Mr. Twist, the Author stated that he agreed that, strictly, the effect of sulphuretted hydrogen in the producer gas should be taken into account. However, he was of the opinion that the unavoidable errors inherent in the preparation of a heat balance probably exceeded the error due to the inclusion of the sulphuretted hydrogen with the carbon dioxide.

In many cases it was impracticable to crush the whole of the clinker in order to obtain a representative sample for analysis. The method to be employed would depend on the amount of fuel handled, on the importance of the test, and on the labour available.

Mr. Twist's estimate of the amount of external work performed by the gas leaving the retorts was correct but the heat equivalent of this work was included in the figure of 700 B.Th.U. which has to be supplied to the charge for the carbonization of one pound of coal. However, the heat equivalent of the external work done by the gas need not necessarily be supplied to the charge since the exhauster could relieve the gas of the necessity of performing this work. The actual heat required for carbonization was dependent on whether the process was endothermic or exothermic.

A simple reply could not be made to Mr. Twist's question as to the temperature drop experienced by the waste gas in the chimney since this depended on the nature, thickness, and height of the chimney shaft, and on the temperature of the gas at the chimney inlet. A suitable allowance would generally be 0·3° to 0·5° F. per foot of chimney height.

As regards the question of the calorific value of carbon, it was now the practice to express thermodynamic functions in terms of β graphite which had a calorific value appreciably less than that of amorphous carbon though the value did not differ much from that of α graphite. The accepted values were 14,544 B.Th.U. per pound for amorphous carbon and 14,136 B.Th.U. per pound for β graphite. In coke which had been heated to a temperature of 1,000° C., the carbon would be mainly in the form of graphite. In Continental practice a figure of 7,950 kg.cal./kg. equivalent to 14,310 B.Th.U. per pound was taken as the calorific value of dry ash-free coke, this including an allowance for the hydrogen present.

Finally, in reply to Mr. Noble, the Author stated that so far as fundamental formulæ for chimney design were concerned, there was no difference in their application whether the chimney was working in conjunction with a carbonizing plant or a domestic gas fire. The temperatures and velocities of the gases in the two cases were, however, quite different. Wind should have no detrimental effect on draught if the velocity of the gas leaving the chimney were sufficiently high.

Vote of Thanks.

A cordial vote of thanks was accorded to Mr. Reber for his Paper on the proposition of Mr. S. C. Waldock (Gas Light and Coke), the Senior Vice-President, seconded by Mr. H. W. H. Butterfield (South Suburban), the Junior Vice-President.

Scottish Eastern Juniors

Visit to Dawsholm

About 27 members of the Scottish Junior Gas Association (Eastern District) visited the Dawsholm Works of the Glasgow Corporation Gas Department on Dec. 11. They were welcomed by Mr. J. Hall, Assistant Engineer, who, with members of his staff, conducted the visitors round the Works.

The Works were reconstructed in 1927, and incorporate many interesting features. Coal-handling plant is installed, including tipplers, breakers, screens, washery, &c. The larger coal is carbonized in Woodall-Duckham vertical retorts and the smalls in the same firm's intermittent chambers. The hot coke from the intermittent chambers is dry-cooled in a Sulzer plant. After the tour of the Works the visitors were entertained at lunch by the Glasgow Gas Committee.

Lunch over, Bailie McIntosh in a few words expressed his pleasure at having a visit from the Eastern Juniors and hoped they had enjoyed their morning. Mr. A. C. Rea, President, replying on behalf of the visitors, asked Bailie McIntosh to convey the thanks of the visitors to his Committee for allowing them to inspect the Works and also for their hospitality at lunch. The last visit to a Glasgow Works had been to Proven in 1922.

The members then proceeded to the Sauchiehall Street showrooms, where Mr. A. Bujnowski conducted them round, explaining the air conditioning plant and general lay-out of the premises. A very interesting hour was spent in this very modern and well-equipped showroom. The members then went on to the Royal Technical College, where a Joint Meeting with the Western District Association was held,

The Effect of Oxygen Content on Purification

by
R. H. CLAYTON, M.Sc.,
H. B. AVERY, M.Sc.(Tech.),
and H. F. TAYLOR, F.I.C.,
of the Manchester Oxide Co.

From a Paper read before the Manchester and District Junior Gas Association following a visit to the Works of the Manchester Oxide Company, Ltd., Miles Platting, Manchester, on Dec. 4—the PRESIDENT (Mr. J. Albinson) presiding.

Mr. CLAYTON having outlined the development of the Manchester Oxide Company, Mr. AVERY said that in the short Paper the practical work had been performed by Mr. Taylor at various works, and for himself and Mr. Taylor he wished to express their indebtedness for the courtesy extended to them, and the opportunity of carrying out the work, by the gas undertakings of Manchester, Leeds, and Brighouse. Although the work had occupied a considerable length of time it could not, by any means, be described as exhaustive. However, the results obtained were sufficiently definite to justify expression at the present time, and it was hoped might act as a foundation upon which further work might be carried out.

The method of purification with which they were chiefly concerned at the moment was revivification *in situ* under more accurate control. The ideal condition was to obtain complete oxidation in the box, using a minimum quantity of oxygen and, in order to do that, the control of temperature became a governing factor. In a Paper abstracted in the "GAS JOURNAL" in 1934 (Jan. 10, p. 90), Dr. Hans Broche, of the firm of Mathias Stinnes, of Essen, suggested a method of purification based on laboratory results, in which he claimed the absorption of H_2S was best conducted at a comparatively low temperature, and allowed that process to proceed in the first box of the series. On the other hand, he claimed that increasing the temperature greatly assisted the absorption of oxygen, particularly with low concentrations. The gas was, therefore, heated before entering the second box where the oxidation process was chiefly carried out.

That system was called the cold-warm method of working, and was claimed to be so advantageous that the rate of oxidation could be increased to such an extent that where formerly one box was required for the sulphiding process, and three for the oxidizing process, it was possible to work with one box for each.

The work to be described by Mr. Taylor was undertaken with the idea of confirming those results under the conditions prevailing in English practice, which were different from those prevailing in German practice, where the coke oven gas contained very little more than 250 grains of H_2S per 100 cu.ft.

Heating the gas at the inlet of the boxes had, of course, been suggested, and practised for a considerable period, and was generally carried out by means of indirect steam heating, although direct steam heating had also been recommended and used. Of the two methods the direct heating with steam was to be preferred on account of the low specific heat of dry gas.

The total heat produced in the combined action of sulphiding and oxidizing was much greater than required to supply all the heat to maintain the gas at a safe working temperature, providing no heat losses occurred, so that complete insulation of the boxes, or prevention of heat loss, would result in the gas becoming considerably overheated.

Insulation of Boxes.

The total heat of reaction during the purification process was 3 B.Th.U. per cu.ft. of gas purified, providing both operations were complete and complete oxidation occurred. When it was considered that one-tenth of that heat was sufficient to raise 1 cu.ft. of gas from 50° to 100°, the actual available heat would be readily appreciated.

The ideal method of controlling the temperature, therefore, was controlled insulation of the boxes. However, the practical difficulties of carrying that out left steam heating, preferably with live steam, as the best way of achieving the desired result. In the trials made both methods had been used. The admission of live steam proved more effective than the method of insulating the boxes, which was carried out by means of straw mattresses that might be moved about. Steam was positively controlled by the size of the jet through which it was admitted, at constant pressure. The results showed that oxidation increased, as was expected, with oxygen concentration, and also with temperature, the oxygen concentration being more effective, so that, while it was easy to increase the rate of oxidation by increasing the quantity of oxygen present, if the latter was maintained at a given minimum, increasing the temperature must be resorted to, in order to obtain satisfactory absorption.

Unfortunately, the whole of the oxygen absorbed was not used in oxidizing the ferrous and ferric sulphides formed, and in practically every case an excess of oxygen absorbed above the theoretical required for the H_2S present was observed. In many cases the excess quantity absorbed appeared considerable, and that was accounted for by the fact that in all spent oxides, ferric or ferrous sulphate were to be found, and it was, of course, obvious that if sulphur were fixed in the form of sulphate, four times the oxygen was required as compared with that required to fix it as free sulphur. The excessive formation of sulphate was the result chiefly of excessive oxygen present and, in extreme cases, might become so high that the oxide became exceedingly acid.

Mr. TAYLOR said that the first of Mr. Avery's points about which he, the speaker, was able to give some figures was the calculation showing that the heat liberated in the processes of sulphiding and revivifying should be ample to maintain the oxide at the required temperature if radiation losses could be reduced to a reasonable figure. In order to study that in actual practice, they determined the temperature of the oxide itself while in operation and compared that with the temperature of the gas leaving the boxes. Upward flow was in use at the works at which the tests were done. To do that a small hole was drilled in the centre of the covers of two of the boxes, and the stem of a long works thermometer was pushed through the hole into the surface of the oxide. With a box which had been recently rotated into first taker position it had been found that the top inch of oxide was at a temperature of about 116° F. under normal working conditions. By the time the gas had travelled through the space between the oxide and the cover of the box, and had reached the outlet main, the temperature had fallen to 88° F.—a drop of 28° F. When the box was in the 2nd, 3rd, or 4th position—that was, when the reaction in it was mainly one of revivification, the temperature of the surface layer of oxide was from 5° to 17° higher than that of the gas leaving the box. The centre of the box would no doubt be considerably hotter than the surface layer. It was therefore obvious that the heat of reaction was being rapidly dissipated by radiation from the cover of the box.

Observations taken at another works, where gas going to the purifiers was warmed by dry steam heaters, and where the gas was flowing downwards through the oxide, showed that a very large proportion of the heat imparted to the gas was lost by radiation in the top of the boxes. Attempts at the first works to conserve, by insulating the purifier covers, the heat liberated in the first taker, and to pass this heat on to the second taker to accelerate revivification there, were only partly successful, because of the difficulty of making the insulating material both efficient and portable, and also because most of the heat conserved was subsequently lost in the mains and rotation valves between the boxes. For purposes of experiment, the insulation method was, therefore, helped out by blowing live steam into the inlet mains and by blowing steam into the lutes of the boxes. By the combined methods, the temperature of the gas leaving the 2nd and 3rd boxes

was raised by about 10° to 20° F., 94° F. being the highest temperature obtained. The data were sufficient for comparison of the oxygen absorption at various temperatures between 55° and 94° F.

The oxygen content of the gas leaving the boxes under varying temperature conditions was then determined and the oxygen absorbed in each box plotted against the temperature. Many complicating factors were encountered, mainly because of the considerable time required to raise the temperature of a box of oxide. During this time the amount of active material in the box was steadily diminishing, and so the conditions of experiment were varying, and other factors, such as the percentage of oxygen in the inlet gases, sometimes varied as well. In order to average out, as far as possible, such variations, a further set of observations was taken, after cooling down to the original temperature. This prevented, to some extent, any confusion of the issue by variations in the amount of moisture caused by the introduction of wet steam, since the conditions were such that, although moisture would be added to the oxide by the steaming process, yet no moisture would be extracted during the cooling down period prior to the 2nd test at the lower temperature. As no dry heating was practised at the works, moisture being added when the oxide was heated, the moisture factor was, for the most part, eliminated in those experiments.

Oxygen Absorption and Temperature.

Mr. Taylor then considered the figures obtained for oxygen absorption at normal and at higher temperatures. When the oxygen absorbed by the oxide in the 2nd and 3rd boxes was plotted against the temperature, in practically every case the oxygen absorption was higher, the higher the temperature, providing other factors were, as far as possible, constant. If a rough average of the inclination of the curves was taken, it appeared that a rise of temperature of 10° F. caused an increased oxygen absorption of about 0·1% of the gas. That was equal to 20% of the total oxygen absorbed. As two or three boxes were usually employed for revivification, it was obvious that if each one was caused to take up 20% more oxygen, the oxide would be in a much more fully revivified condition by the time it reached the position of first taker again, and would take up a much larger percentage of sulphur before becoming exhausted. Alternatively, when the temperature of the boxes could be raised it should be possible to reduce the amount of oxygen entering the purifiers, since the lowering in the rate of revivification which would otherwise result would be counterbalanced by the effect of the higher temperature.

Preliminary experiments at a works fitted with preheaters for the gas gave results which pointed in the same direction as those cited, but they could not attach too much importance to them, because the conditions obtaining at that works did not allow sufficient time for the temperature changes to be made satisfactorily. In spite of that, however, those preliminary figures, for the most part, fell in with the rule that oxygen absorption varied directly with temperature. The figures were, as a rule, very similar to the previous ones, but there were many exceptions, because of the innumerable complications which occurred. Therefore, the foregoing figures were not based entirely on observations at one works.

In considering the question of revivification *in situ*, it must be borne in mind that a considerable part of the revivifying process took place in the first box alongside the sulphiding process. Revivification was not restricted to the 2nd, 3rd, and 4th boxes; quite a lot took place in the first as well. When the oxygen admitted to the purifiers was fairly high, say, in the neighbourhood of 1½%, it was found that from ¼% to ¾%, an average of about half of the total oxygen absorption took place in the first box. When the oxygen at inlet to purifiers was lower, say, 0·7%, the first box absorbed a much smaller proportion of the oxygen, only about a quarter of the total absorbed by the four boxes. The oxygen absorbed by the first box appeared to follow, to some extent, the H_2S absorbed by the same box, but the number of conflicting factors involved was too large to enable any definite conclusions to be drawn.

When the oxygen at the inlet to purifiers was very low the system was remarkably sensitive to small changes in that factor, a small reduction in the oxygen at the inlet purifiers sending the sulphiding action more and more into the 2nd and 3rd boxes. To take a typical example of this effect of concentration of oxygen at the inlet to purifiers, an increase in the oxygen content from 0·6% to 0·8% increased the absorption of H_2S by the first box from 40% to 65% of that present in the crude gas. If the 2nd box was taken into account, similar results were met with, the percentage of H_2S passing the 2nd box falling from about 33% to an average of 6% of that entering the set when the oxygen was increased from 0·6% to 0·8%.

It was not quite correct to assume that the whole of the oxygen absorbed in the purifiers had been used in revivifying sulphided oxide. At both works where tests were made, revivification *in situ* should, on such a basis, have been complete, since the oxygen absorbed was invariably equivalent to, or more than equivalent to, the H_2S absorbed; but it had been found that when the oxide was discharged at the end of a normal backward rotation cycle, a rise in temperature invariably occurred as the air diffused into the heaps of oxide, showing that much unrevivified oxide was present.

At Leeds, for example, there were present in the inlet gas about 570 grains H_2S per 100 cu.ft. of gas. That was about 0·9% by volume. The oxygen normally absorbed during the passage of the gas through the purifiers was about 0·5%; that was, just slightly more than the 0·45% theoretically required to oxidize all the sulphide, but on discharging the oxide it was found that it was never fully revivified. When the 2nd and 3rd boxes were worked at higher temperatures, the oxygen absorption rose to about 0·7% of the gas and sometimes to as much as 1%, or more than double the theoretical required to oxidize all the H_2S.

At present it could not be said what proportion of the increased oxygen absorption induced by higher temperatures was due to straight revivification, and what proportion to the side reactions which undoubtedly took place both at high and low temperatures. Although high temperatures were sometimes said to be responsible for the appearance of acidity in the oxide, there was good reason to believe that lack of moisture had a more detrimental effect in that respect, particularly in combination with high temperatures.

In conclusion, it had to be acknowledged that the work described was far from complete. It was very difficult for workers from outside the gas-works to carry such researches to their logical conclusions, mainly because the final criterion of the value of working the purifiers at higher temperatures was the percentage of sulphur present in the oxide after one exposure under normal conditions, as compared with the percentage of sulphur present when the oxide had been worked under conditions identical, except that the temperature was higher. That involved control over a period of several months and plant facilities which were not easily obtainable. The ideal would be to have one set of purifiers working at a fairly low temperature and another set in parallel, on the same gas, at a fairly high temperature, each being charged with the same oxide. Also, each set should have a meter to indicate the amount of gas passing; a facility which was, unfortunately, very seldom available.

In the absence of experiments done under such ideal conditions it was hoped that there would be published from time to time accounts of experiments which, though less comprehensive, would, nevertheless, do something to help the Industry to increase its knowledge of these aspects of purification.

Discussion.

The PRESIDENT (Mr. J. Albinson) thought that the Authors had recorded, in a definite, positive manner, the facts that had previously been known in a vague kind of way in operating conditions; that if a set of purifiers was in an exposed position, in cold weather it began to slack off in reactions. It was surprising that there was so much heat available from the reaction itself. He thought that future developments of purification would certainly have to take cognizance of that fact, and devise suitable lagging, or protective means to stop the dissipation of heat, which was so essential for the correct operation of the purification system.

A MEMBER mentioned a case in which H_2S which had been generated in the box had risen as high as 40 grains. He hardly thought it would be due to the inter-action of ammonia or CS_2, but rather to the inter-action of ammonium sulphocyanide and ferrous sulphide. If they increased the oxygen, admittedly it speeded up the rate of clearing. He was wondering if Mr. Avery or Mr. Taylor had any information regarding reaction velocity of the oxygen on the various points.

Mr. AVERY said that with regard to the question of throwing-off of H_2S from the boxes, obviously, if as much as 40 grains was being evolved, it was impossible for normal quantities of CS_2 present to give that amount. It might, as had been suggested, be partially due to acidic condition from the presence of ammonium sulphocyanide, and its action on the ferrous sulphide in the boxes. Again, it might be that the bottom of the box was not perfectly clean and there was a deposit of liquor lying dammed in pools by a small quantity of oxide which had

fallen through the grids. If that box had been passing a fair amount of H_2S the liquor in the bottom of the box would absorb a certain amount of ammonium sulphide, and when that box came round to the last taker a certain atmosphere of H_2S might be evolved from the liquor still in the box. The oxide lying in the liquor would not absorb the H_2S, perhaps partly because it was far too cold, and in several cases when that happened generally the amount evolved was not very great, but gave sufficient to show a distinct stain when that box came on as the last taker.

Mr. H. H. THOMAS (Liverpool) proposed a vote of thanks to the Authors of the Paper. He thought that the increasing of the absorption of oxygen was a highly desirable thing to achieve, but his experience as a gas engineer was that nervousness was experienced when the temperature of the box rose. Some engineers considered 85° F. high, others considered 90° F., and some even went up to 95° F.

Mr. A. K. COLLINGE (Preston) thought that the best way he could second the vote of thanks was by mentioning that in Preston, some years ago, they had adopted the methods described in the Paper, on the suggestion of the Manchester Oxide Company and had met with complete success. Live steam was admitted, and the boxes were lagged. Steam could be admitted at 20 lb. and temperatures controlled as desired. The amount of steam admitted was controlled by the readings on the thermometers, and its extent was such that the oxide was not unduly wet. Water had to be added to the oxide when it was out, which resulted from the lagging of the boxes being more effective than was necessary. He thought that no higher praise could be accorded to the Authors of the Paper than that the system they recommended had met with regular success.

The vote of thanks was carried unanimously, and the members adjourned to the canteen of Hardman & Holden, Ltd., where the Mono continuous oxygen recorder was exhibited, recording the oxygen in the Manchester town gas.

The apparatus is the first of its kind to be used in this country, and is of German origin, although it will, it is understood, shortly be manufactured in England.

French Gas Industry

Review of the 60th Congress of the Union Syndicale de l'Industrie Technique du Gaz en France

Continued from p. 866.

Ventilation Technique and the Installation of Gas Appliances in Dwelling Houses

G. Richard discussed the question of the ventilation of dwelling houses, with particular reference to the subject of gas appliances.

The various factors which influence the overall ventilation of residences and, particularly, of flats were reviewed and the effect of internal and external pressure conditions was described. In this connection, such aspects as the relative positions and grouping of the different types of rooms, the arrangement of the corridors, the heights of the doors, the influence of lift shafts, &c., received attention. Consideration was given both to natural and to forced ventilation. The difficulties sometimes experienced in the evacuation of the products from gas appliances under conditions of natural ventilation were pointed out and the means whereby these difficulties may be overcome were indicated.

A classification of flue systems was given in relation to the types of appliance and the conditions of use for which they are suited, *i.e.*, high and low waste gas temperatures (above 250° C. and below 150° C. respectively), diluted or undiluted waste gas, abrupt or gradual starting up, large and small rates of gas consumption, and continuous or intermittent use.

Finally an account was given of the methods which may be employed for the study of ventilation with the help of smoke generators, anemometers, micro-manometers, hygrometers, and gas analysis apparatus for the determination of carbon dioxide and of carbon monoxide. Suitable portable forms of apparatus were described and exhibited by the Author, who emphasized the importance of the use of these simple means for ensuring the regulated degree of ventilation necessary for the good performance of gas appliances and the evacuation of their combustion products.

(To be continued.)

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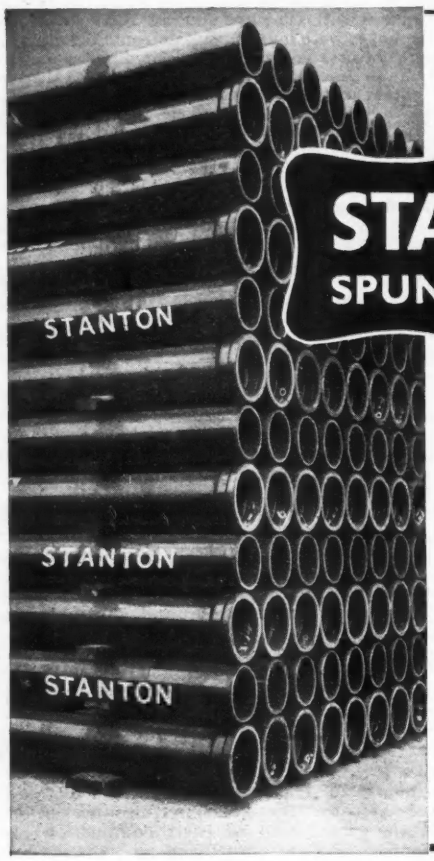

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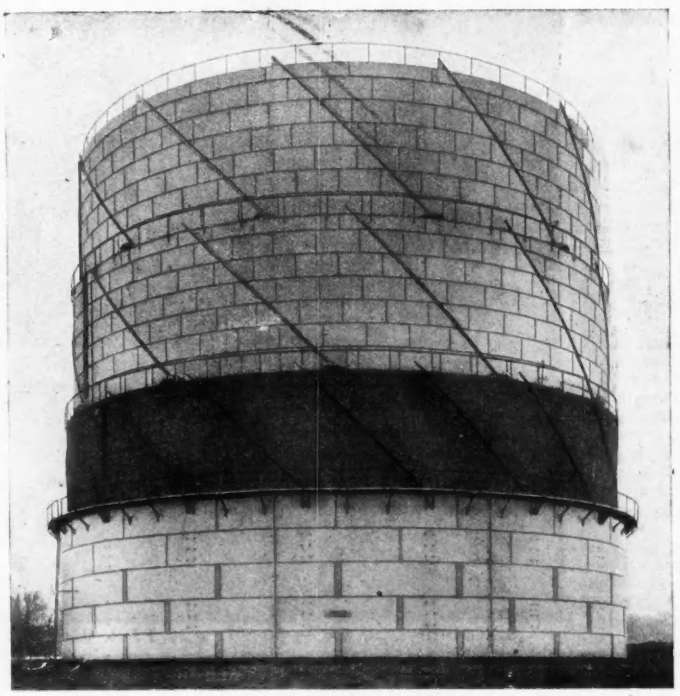

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Retaining the Cooking Load by Vitreous Enamelling

by
F. A. C. PYKETT,
Distribution Engineer to the City of Coventry Gas Department

From a Paper read before a meeting of the Midland Junior Gas Association held at Birmingham on Thursday, Dec. 2—the PRESIDENT (Mr. E. T. Pickering) presiding.

For some years now one of the most frequently used sayings in our Industry has been "The black cooker must go." The Technical Press have stressed this in no uncertain manner. How many gas undertakings have made any decided effort to eliminate the black cooker? I should say there are still some millions in use, and in many areas no effort is being made to eliminate them.

We all appreciate the problem is an expensive one, but careful consideration should always be given to the advisability of spending money to retain what we already have. It is in many instances as economical to do so as to spend large sums of money in obtaining new loads. Sometimes, I think, in search of the latter there may be a tendency to neglect the former. It does not appear so long ago to some of us that our Industry, or at least some of those responsible for its guidance, did not regard electricity for lighting as a serious competitor. There is today, with many undertakings, a similar feeling with regard to the electric cooker. Those who feel so contented and ignore the competitor will receive a rude awakening when they suddenly realize the great inroads that have been made into this load.

About four years ago the Electricity Department of the Coventry Corporation launched a cooker campaign, and commenced to hire cookers to householders at rates ranging from 6s. 6d. to 9s. 6d. per quarter. These appliances were the latest and most modern all-enamelled finish. The Gas Department at that time were fortunate, because the sales organization was well established, but its activities had been somewhat restricted by the fact that high-grade all-enamelled cookers were only offered on sale, or three years' deferred terms. In view of the competition mentioned, it was decided the policy should be modified. The payments on deferred terms were extended to five and seven years for high-grade appliances.

It was also decided that one type of high-grade cooker should be placed on simple hire terms, to compete with that of the Electricity Department. At this period we had some 45,500 gas cookers on simple hire, and probably only 2,500 of the all-enamelled thermostatically controlled type which had been purchased by consumers. It will be appreciated how serious was the competition with which we were faced, having over 45,000 black cast-iron cookers. The alteration of our terms, and the placing of a high-grade cooker on simple hire terms, may be classified as a step in the right direction, but such procedure would not go far enough towards the elimination of the black cooker, and we felt these were a great handicap. It was also anticipated that the stock of these cookers would begin to accumulate at our works, as they were replaced by customers purchasing or hiring the all-enamelled appliances, now on more attractive terms. The people, comprising a large percentage of our black cooker hire, were those who perhaps could not afford even 6s. 6d. per quarter for an enamelled appliance, and we wished to enable these people to have something better. It was decided that the cookers returned from the district, in place of high-grade appliances, should be reconditioned in finishes other than black.

As probably many of you are aware, porcelain enamel is a ceramic material very much like glass, and is melted at a white heat. This material must not be confused with paint, lacquer, or soft enamel, or any of the various synthetic finishes which are stoved at low temperatures up to, say, 500° F. All such finishes are organic and they change and deteriorate in service, whereas porcelain enamel is inorganic, of mineral origin and changeless. We had been experimenting for some time with a view to obtaining experience of the synthetic finishes, and an excellent finish in mottled enamel was obtained. The process, however, offered many difficulties, especially in obtaining perfect finishes. These finishes were hardly distinguishable from vitreosil. Approximately 24 of the best specimens were placed on the district and in one or two of the works messrooms, but from observations we came to the conclusion the only serviceable paint finish was black.

Vitreous finish appealed to us if it were possible on existing castings. It is generally understood that castings designed for enamelling have no sharp corners. The older types of cooker casting are in many instances unsuitable, both in regard to design and mixture; furthermore, they have been in use for some considerable time. These difficulties all contribute to a rather heavy percentage of breakages which may occur during the process. The leadless enamel has very definite advantages, for in addition to not containing such an undesirable constituent as lead, it is much harder, and more lasting finishes are obtained. The old lead enamels often used to show slight discoloration, or sheen effect, due to the lead content.

The leadless enamels are more difficult to process, and it is very important that the articles to be enamelled in these harder enamels should be very carefully treated if good results are to be obtained. Furthermore, these enamels will resist staining when in contact with the various acids, such as fruit juices, encountered in the kitchen.

In the early days of wet process enamelling for cast-iron, enamels containing lead were used in larger quantities, due to the high lustre finish and, what was very important in those days, the easy fusing properties. Very naturally the various authorities took exception to the use of enamels containing lead, and the Industry itself made continuous progress, and since 1934 leadless enamels of high lustre have been available for all finishes.

Enquiries solicited did not at first hold out any great promise, although we had for some time had gas fire castings suitably finished. In one instance twelve complete sets of cooker parts were sent to an enamelling firm and upon return it was only possible to erect three complete cookers. The remaining parts were so distorted and warped that they had to be scrapped. However, another firm offered and assured us of much better results, and from a sample of twelve sets sent, in this instance, it was found possible to re-assemble the whole. These were immediately placed in works messrooms and on the district, and kept under observation. Although it was possible to test them under these conditions for only a short period, we felt this finish would fulfil our requirements.

The whole question was discussed with the firm's representatives, and it was decided to commence with some 50 cookers per week. The Gas Department were to dismantle the cookers, and clean by the usual method of boshing the parts to be sent away for enamelling. The parts comprised door complete and frame, two sides, two bridges, inner dome, outer dome or crown plate, and the cornice; nine parts per cooker. All parts were to be finished in mottled enamel, except the inner dome, which only had a priming coat, and the outer dome, or crown plate, which was to be finished in white. This latter process eliminated the necessity of loose crown plates.

The enamellers collected the parts, finished them, and returned same to our works for assembly. The back of the cooker, burners, rests, grids, gates, and top bars were finished in black paint by the Gas Department's workmen.

It was considered advisable to keep each door and door frame together, and they were therefore "tagged" with corresponding galvanized number plates.

The process of vitreous enamelling is generally as follows: The castings are first annealed at a temperature slightly above the temperature that will be required for fusing on the enamel. In the case of old castings this process of annealing also achieves the object of burning off japan, grease, &c. The boshing mentioned previously was therefore not necessary. Following this the castings are subjected to cleaning by shot blasting, using special angular steel shot and air at a pressure of 60 to 80 lb. per sq.in. The shot blasting operation is a costly and lengthy

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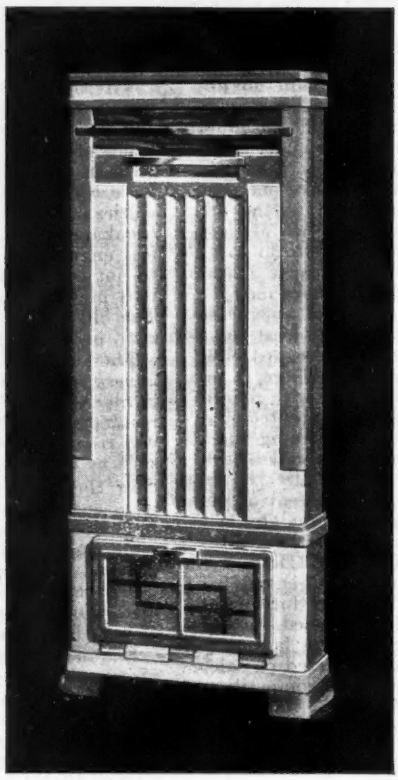

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process, as it is essential that the castings should be thoroughly clean before being processed, and the surface well cut up to form a key for holding the enamel. The air which is used for shot blasting must be free from oil and moisture.

Following the shot blasting the castings are thoroughly freed of all dust by blowing them over with compressed air; they are then sprayed with the first coat of enamel. The enamel is ground to a very fine powder, and suspended in water for spraying purposes.

When the enamel has been sprayed upon the castings they are immediately placed in a drying stove and rapidly dried, which process removes the water and leaves the enamel evenly coated on the castings. The castings are next placed on burning bars of suitable construction to support them properly, and are fused in a muffle at temperatures between 1,500° F. and 1,550° F. Although every effort is made to keep the castings perfectly straight or in true form during the process of fusing, this is not always possible, and then the castings have to be straightened after leaving the furnace.

After the first fusing the castings are allowed to cool, and are then sprayed with the cover coat, dried, and re-fused. The number of times that they are sprayed and re-fused depends entirely upon the finish that has to be achieved. Following this process the castings are passed out for inspection, and if any parts are rejected it becomes necessary to strip the enamel from the castings and pass them through the complete process again. The stripping is achieved by shot blasting, but naturally takes a very much longer time than the ordinary cleaning of castings by shot blasting. It is therefore essential to exercise the greatest care in the process, otherwise the cost of re-processing becomes a very heavy item.

The most difficult part of the erection of the cooker is the facing of doors to fit the frames, and we spend some considerable time on this part of the work because we try to make the door hold at all points a piece of test paper 5/1,000 in. thick. I understand this is the practice of manufacturers with their new appliances. Our shops are not suitable or designed for the introduction of methods of mass production, but we find it advisable to allow men to do special jobs, rather than be allowed to build the cooker complete. The men become more skilled at one particular job, more especially those of door fitting and erecting. It is necessary to re-tap all screw holes, and to enhance the appearance of the cooker all assembling screws are finished with screws with polished chromium heads. One noticeable feature was the increase in quantity of new inner enamels used in the shops, and it was found this was due to the fact that those which had received considerable wear could be replaced in a black appliance, but the condition was hardly suitable for the cleaner-looking all-enamelled finish. After overcoming the smaller initial difficulties and training the men on special parts of the erecting, the demand began to increase and the quantities were increased to 100 sets per week and shortly afterwards up to 150 sets per week. For a short period it was found necessary to try to obtain 180 sets, but this was some tax upon our shops and men and necessitated considerable overtime. You will appreciate how fortunate we were in being able to send large quantities of the same make of appliance.

Defective and damaged parts form about 3% to 4% of the total parts treated, and in view of the remarks mentioned previously respecting breakages and failures, this is considered most reasonable, especially when it is remembered the parts are sent away in a dirty unexamined state. The defects from the enamelling were not as high when we boshed the parts and examined them prior to sending forward, but, of course, the total was approximately the same. Progress at the rate of 150 sets per week was continued for some 18 months to 2 years with every satisfaction.

The demand for these renovated cookers has always exceeded the supply available, but the resultant time lag has materially assisted our sales staff to convert enquiries for hired cookers into sales of higher-grade appliances, with advantage to both customers and undertaking.

It may also be interesting to you at this point to state how we named the cooker. They are known generally as "Reno" cookers and under this name they were introduced to the public.

Until then the whole of the appliances treated were of the cast type—that is, cast backs, sides, and doors—except that some doors had a white enamelled front plate. Stocks of this type were now getting depleted and smaller quantities were coming in from the district. We had, however, accumulated quite a large number of cookers of the sheet steel enamelled-sided type. This cooker had rather a heavy type of cast-iron door which looked far from attractive even when enamelled. There was still a great demand for the "Reno" cooker and it was decided to renovate these with enamelled sheet steel appliances. The cost was likely to be greater because there was little saving in cast-iron enamel costs and the appliance required three outside sheet steel sides. Furthermore, the door being unsuitable it was decided to consult our enamellers with a view to making a new pattern. This called for considerable skill on their part but the result was most satisfactory and over 1,000 were enamelled. At the moment we are doing a further 1,000 of the same type but a smaller size.

We had at various times during the progress of this work approached many enamellers with a view to having existing sheet steel sides enamelled, but the samples submitted were most unsatisfactory. This was principally due to the state of the sheet steel after the removal of the old enamel. In this state it is so thin that the heating to fuse the new enamel causes distortion and warping. Our present enamellers knowing our requirements have now approached us with a method of enamelling over the old enamel and from specimens submitted these have every appearance of being satisfactory. So much so it has been decided to do the second thousand with this class of enamelling. It is left entirely to the enamellers to use their discretion upon the quality of the old sides. Very few are, however, rejected and by this process the cost of re-conditioning the second 1,000 is going to be much less than the first, the cost of the enamelling of the old sheets being approximately half the cost of new sheets. This cooker also required a new door similar to the other one mentioned.

We have now been carrying out this policy for some four years and placed several thousand appliances on the district. Cookers of the enamel finish began to be returned to our works for various reasons, and these, of course, again required cleaning. At first they were totally dismantled, but it was felt unnecessary to strip them after such short service. A process of semi-incineration was adopted which consists of taking off the cornice and bridges, placing the cooker in a suitable chamber and leaving a large ring burner burning inside the cooker, the thermostat having been removed. The fat and grease are all charred to a white powder even in the corners of the linings. The cooker is then removed and allowed to cool, after which it is scratch brushed inside and outside by means of a flexible shafted brusher. It is found necessary to re-bed the top dome and door panels, after which the enamels are polished and the other parts assembled. The time by this method was reduced from 7½ hours to 4½ hours.

The cost of re-enamelling the cooker amounts to 42s. 6d. varying to 50s. according to the type and size. This includes all charges, dismantling, transport, enameller's costs, new parts and assembling, testing, &c. To cover the cost of this work the appliances are hired out at rates ranging from 2s. to 4s. 6d. per quarter according to size of cooker. The hire charge is based upon a 10 years' life. From our experience over a period of 4 years this basis appears quite reasonable. The number placed upon the district totals 19,700 although the supply is at present reduced to between 80 and 100 cookers per week. With the facilities provided for the purchase and hire of high-grade appliances we can safely say that approaching 80% of our consumers have an enamelled cooker. The procedure has created the impression among our customers that the Department is progressive and out to give the consumer, who cannot afford the high-grade appliances at least one which is more attractive in the kitchen than the old black appliance. The policy adopted is one which I feel could be followed by other gas undertakings.

Discussion.

The PRESIDENT (Mr. E. T. Pickering, Birmingham) said he admired the Coventry Gas Department for their forward policy in connection with this important matter. The public had little opportunity of judging how up-to-date they were in regard to gas manufacture, and so their opinion had to be based on appliances. Vitreous enamelled cookers provided something that could be appreciated straight away. More and more attention was being given to amenities in the home, particularly in kitchens and bathrooms. In the former, people must have cookers to match tiles and in keeping with the bright and clean kitchens that were now being erected. It was not every woman who could have a modern kitchen, but when she saw a modern cooker she wanted one, even if she could not have a kitchen to go with it. Of all the appliances they sold, it seemed to him that the gas cooker was the most important because three out of every four women used a gas cooker, so that their experi-

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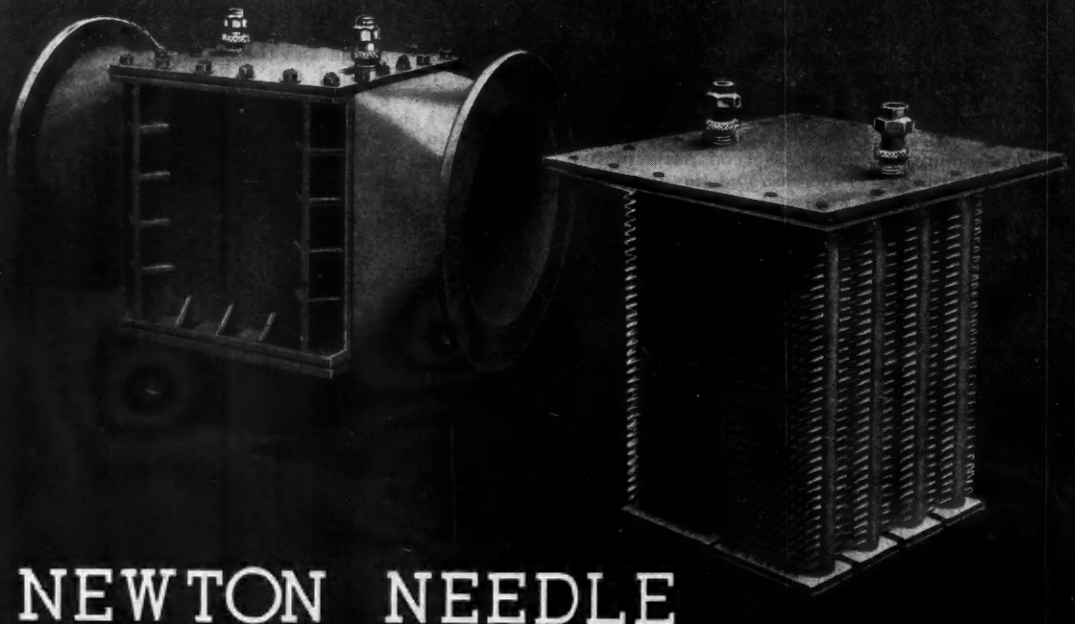
But these are not the only advantages. The elements are of a special cast iron so that you have no corrosion problems. Less tubes are necessary and less space is occupied. In actual fact the saving of space over other types is anything up to 40%.

The Newton Needle Gas Heater is built to last, so that considering how low is its initial cost, it is indeed an economical installation.



NEWTON NEEDLE
STEAM HEATED GAS HEATERS
NEWTON CHAMBERS & CO LTD THORNCLIFFE NR SHEFFIELD

ence with a gas cooker was going to be, to a large extent, their experience with gas. If it were satisfactory they would probably invest in further appliances.

Mr. A. W. ATTWOOD (Coventry), in proposing a vote of thanks to Mr. Pykett, reminded members of the Author's services to the Industry in Yorkshire and Manchester, as well as in the Midlands. A few years ago he was President of the Midland Junior Gas Association, and he was sure that the members of all the Associations had derived benefit from his work and from the practical knowledge he had imparted from time to time. It seemed to him that largely through Mr. Pykett's efforts Coventry had done something to solve a difficult problem, and had killed two birds with one stone by disposing of the old black cookers and by giving a cooker of good appearance to a class of consumers who probably could not afford a high-grade cooker. He agreed that undertakings should not be satisfied with the present state of affairs regarding the cooker question because the electricity industry was sparing no effort to increase business in this direction.

Mr. W. N. SMIRLES (Birmingham), in seconding the vote of thanks, said he came there to learn a little more about vitreous enamelled cookers, and he thought a considerable amount of light had been thrown on the subject. They would all endorse the remarks that had been made regarding electrical competition. As years went on that competition must become more intense, and he was in doubt himself at times whether processes of this type were really an economic proposition and whether they would eventually enable them to retain the important cooker load. They had to consider the economic position of the consumers whom these cookers were supposed to serve. Their gas bills might be of such a size that an undertaking made very little out of the sale of gas to them.

The resolution of thanks was heartily carried.

Mr. S. BROCKBANK (Walsall) said the subject dealt with was one of the most important on the supply side. In Walsall they thought it was better to scrap the old black cookers and offer modern ones on long term hire-purchase terms. While the ten years during which it was maintained was a long time in the life of a cooker, he thought it should not be difficult at the end of that time to persuade the consumer to enter into an agreement for a new cooker.

Mr. H. R. LAWTON (Stourbridge) said his Undertaking had endeavoured to get rid of the black cooker which was a bugbear and was not up to the standard of the Gas Industry to-day. Builders were improving kitchens and naturally black cookers looked out of place with bright tiles.

Mr. K. L. PEARCE (Bilston) pointed out that the old type of cooker while modern in finish was not so in performance.

Mr. W. D. CADWALLADER (Birmingham) said in Birmingham they had been substituting black cookers with enamelled ones for slot consumers for between two and three years. They had about 50,000 of the enamel type in use and there was still a big demand for them.

Mr. F. A. JENKINS (Leamington) said there was no doubt an old type cooker used a lot more gas than a packed type, and he wondered if it would not pay to offer re-enamelled unpacked cookers at a really low charge or at no charge at all. In Leamington they had tried renovating cookers but the results had been very much the same as the first results stated to have been obtained at Coventry.

Mr. J. H. WAINWRIGHT (Halesowen) said they were fortunate in his district in having very few simple hire cookers. They had run the slogan " scrap your old black cooker " with every satisfaction to themselves.

Mr. W. MCNAUGHTON (Wolverhampton) questioned the value of vitreous enamelling in combating the keen competition with which they were faced. Would it not be better, he asked, to introduce consumers to a modern thermostatically controlled cooker?

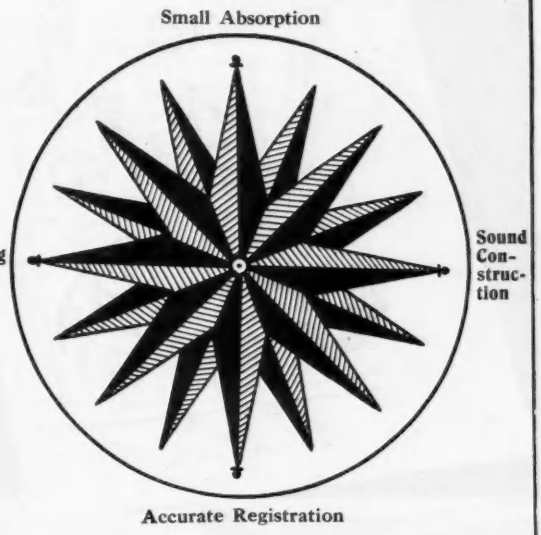
The Author's Reply.

Mr. PYKETT, in reply, said they had scrapped a lot of the old cookers but they could not afford to do that in respect of all of them. As a matter of fact, up to the time the scheme was started they were purchasing black cookers, and these were reasonably modern as far as design was concerned.

Answering the various points raised, he said if a customer wanted a special colour, then a modern cooker should be sold. In Coventry they had not purchased any single case cookers for some years, and all cookers which they had enamelled were the packed type. In re-fitting parts they had sometimes found it necessary to file off excess enamel. In many instances the enamellers had helped them by wiping off certain parts before fusing. They did not fit thermostats to these cookers. It was out of the question to deal with consumers' own cookers. The inside parts were dipped in black enamel ordinary air drying paint. In Coventry they believed that this work had helped them to a very great extent to fight the competition with which they were faced.

Mr. GRIFFITHS (Sales Manager, Messrs. Harper & Co., Willenhall) said they had an acid-resisting enamel irrespective of whether it was on lead or leadless. His firm reconditioned cookers fitted with thermostats and they were a perfect success.

All the Cardinal Points



ARE CAREFULLY WATCHED IN THE CONSTRUCTION OF OUR METERS

OUR HIGH CAPACITY METERS

are specially designed for their work and register accurately, with a minimum of pressure loss under

The most severe tests

MANY SPECIAL AND DISTINCTIVE FEATURES ARE INCORPORATED AND ARE WELL WORTH YOUR EXAMINATION.

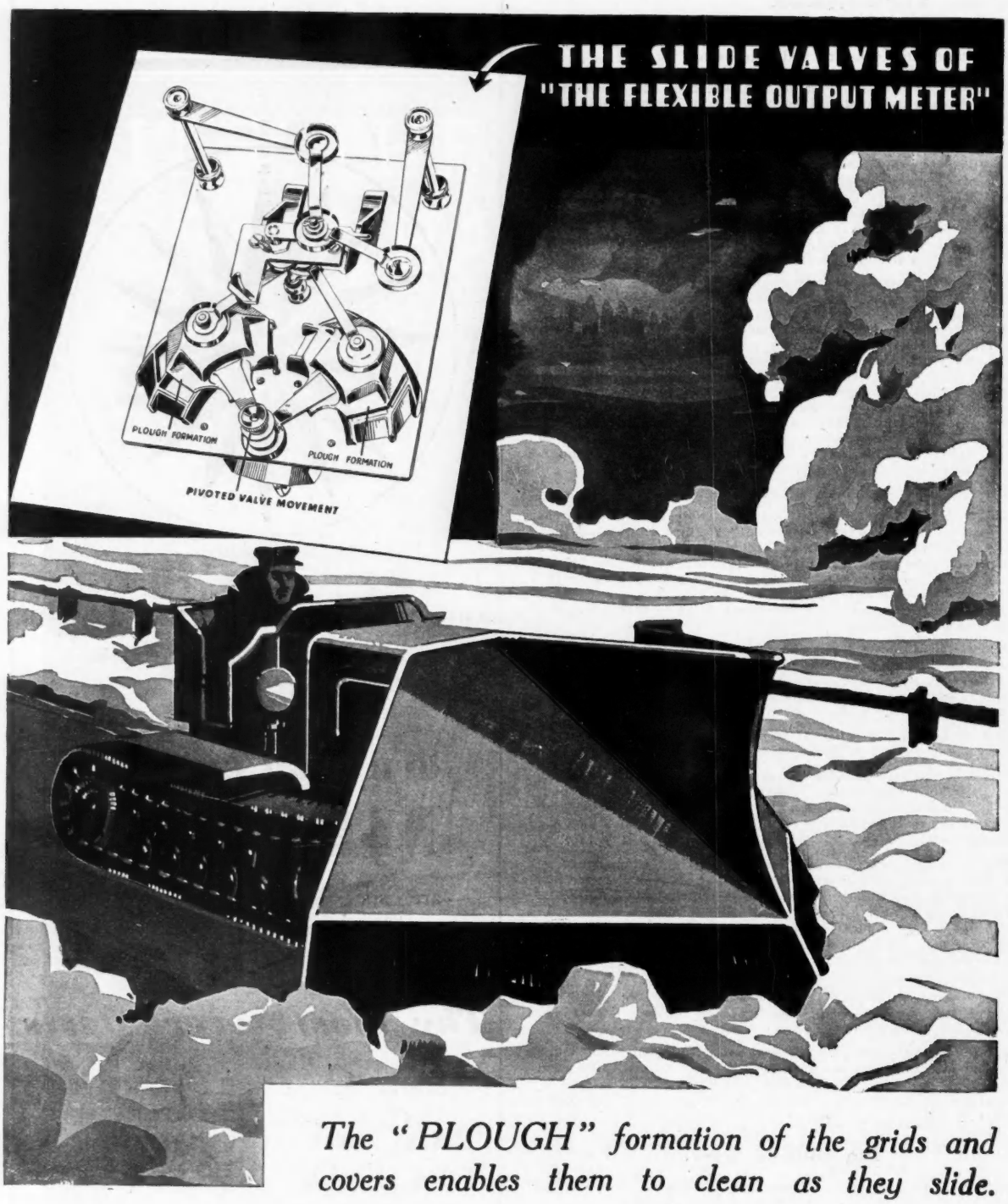
SAWER & PURVES

(BRANCH OF METERS LTD.)

DERBY ROAD,
WATFORD.
Phone: 2645.

Radford Meter Works,
Radford Road,
NOTTINGHAM.
Phone: 75202.

Nelson Meter Works,
Miles Platting,
MANCHESTER.
Phone: 2289 Collyhurst.



The "PLOUGH" formation of the grids and covers enables them to clean as they slide.

J. H. ROBINSON & Co. (LIVERPOOL) LTD.

Chief Office and Works: MILL LANE, OLD SWAN, LIVERPOOL.

Phones: OLD SWAN 2484 (3 Lines)

'Grams: DIAL, LIVERPOOL.

Branches - - EDINBURGH and DUBLIN

'Grams: DIAL, LEITH. DIAL, DUBLIN.

Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

A much brighter tone prevailed on the Stock Exchange last week. The volume of business increased and prices in many directions began to move upwards. British Funds closed fractionally higher, and home rails provided some good features. The recovery gave a fillip to the almost lifeless condition of the industrial section where the upward trend of prices was most noticeable, though with some end-week profit taking in evidence values closed below their best. An event of the week was the success of the Huddersfield issue of 3½% stock at 101. Applications were received for nearly five times the amount required, and the stock has since been dealt in at 5s. premium. Coventry is making an issue during the current week on the same terms.

The increased activity in the more speculative sections was responsible for a slight falling off in the volume of business in the Gas Market, and though prices were inclined to react, the quotations with few exceptions remained unchanged. Gas Light units suffered a relapse and closed 6d. lower at 25s., British ordinary recorded a sharp fall of 6 points to 139-144, and a parcel of this stock is on offer at the higher price to give a yield of £5 4s. 1d.%. Imperial Continental weakened 2 points to 137½. There were the usual *ex* interest markings at this time of the year, and apart from these the quotations at the Provincial Exchanges and in the Supplementary List closed unaltered.

The lists of stocks available this week include parcels of 5% perpetual debenture stocks of the Commercial and South Suburban Companies, both offered at 118 giving the high yield of £4 4s. 8d.%.

Current Sales of Gas Products

The London Market for Tar Products.

Dec. 20.

Prices of Tar Products in the London markets remain as quoted on the 13th inst.—namely:

Pitch, 38s. per ton f.o.b.
Creosote, 5⅞d. to 6d.
Refined tar, 3¾d.
Pure toluole, about 2s. 4d.; pure benzole, 1s. 9d.; 95/160 solvent naphtha, 1s. 7d. to 1s. 8d.; 90/160 pyridine, 11s. to 12s.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Dec. 20.

The average prices of gas-works products during the week were: Gas-works tar, 25s. to 30s. Pitch—East Coast, 38s. to 40s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 38s. to 40s.* Toluole, naked, North, 1s. 8d. to 1s. 9d. Coal tar, crude naphtha, in bulk, North, 8d. to 8½d. Solvent naphtha, naked, North, 1s. 5½d. to 1s. 6d. Heavy naphtha, North, 1s. 3d. to 1s. 3½d. Creosote, *ex* works, in bulk, North, liquid and salty, 5d. to 5½d.; low gravity, 4⅝d. to 4½d. Heavy oils, in bulk, North, 5d. to 5½d. Carbolic acid 60's, 3s. 9d. to 4s. Naphthalene, £14 to £17. Salts, 80s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal; "B" quality unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Dec.* 18.

There is still very little new business being arranged and possibly the position will now remain rather dull until after the holidays.

Crude gas-works tar.—Actual value is 37s. to 38s. per ton *ex* works in bulk.

Pitch is valued at 30s. to 32s. 6d. per ton f.o.b. Glasgow for export, and 30s. per ton *ex* works in bulk for home trade.

Refined tar continues to be offered at 3d. to 3⅛d. per gallon free on rails for export, and 3½d. to 3¾d. per gallon *ex* works in buyers' packages for home trade.

Creosote oil is changing hands in quite substantial quantities but values show a slight decrease as under: Specification oil, 5⅛d. to 5⅜d. per gallon; low gravity, 6⅛d. to 6⅜d. per gallon; neutral oil, 5d. to 5⅛d. per gallon; all *ex* works in bulk.

Cresylic acid remains very quiet and in the absence of business prices are more or less nominal as under: Pale, 97/99%, 3s. 3d. to 3s. 6d. per gallon; dark, 97/99%, 3s. to 3s. 3d. per gallon; and pale, 99/100%, 3s. 9d. to 4s. 3d. per gallon; all *ex* works in buyers' packages.

Crude naphtha remains steady at 6d. to 6⅛d. per gallon *ex* works in bulk, according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 5d. to 1s. 6d. per gallon, and 90/190 heavy naphtha, 1s. to 1s. 1d. per gallon.

Motor benzole continues steady at 1s. 4d. to 1s. 4½d. per gallon.

Pyridine.—Prices are nominal at 11s. to 12s. per gallon for 90/160 grade, and 12s. to 13s. per gallon for 90/140 grade.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole . . .	0 9½	to	0 10	per gallon at works
Motor ,, . . .	1 3	,,	1 3½	,, ,, ,,
90% ,, . . .	1 4	,,	1 4½	,, ,, ,,
Pure ,, . . .	1 8	,,	1 8½	,, ,, ,,

Contracts Advertised To-Day

Resheeting Gasholder.

Stockport Gas Department. [p. 954.]

Silica Refractory Retort Material.

Stockport Gas Department. [p. 954.]

Overseas Opportunities

Pietermaritzburg.

H.M. Senior Trade Commissioner in South Africa reports that the City of Pietermaritzburg (City Engineer's Department) is calling for tenders (Contract No. 42) for the supply and delivery of 7,800 ft. of 8-in. and 1,200 ft. of 4-in. diameter cast-iron spigot and socket pipes, together with quantities of flanged sluice valves, surface boxes, spigot and socket standard bends, tapers, standposts, duckfoot bends, collars, plugs, tees, angle branches, and jointing material.

Tenders, endorsed "Contract No. 42 of 1937" (Cast-Iron Pipes, &c.), should be addressed to the Town Clerk, City Hall, Pietermaritzburg, Union of South Africa, by whom they will be received up to 2.15 p.m. on Dec. 31, 1937. (Ref. T. 31461/37.)

Athletic and Social

"Suburbagas" Dance.

Over one hundred and fifty members and friends of the Suburbagas Social and Athletic Club assembled on the evening of Saturday, Dec. 11, at the Royal Bell Hotel, Bromley, for a gala dance, which was well organized by Mr. W. E. Hickmott, Hon. Secretary, and Mr. H. Long. The spot prize-winners were: (1) Miss J. Hodgson and Mr. F. Lovell; (2) Miss P. Pollock and Mr. W. D. Partridge. A dancing competition was won by Mr. Buckland. Mr. P. Price acted as M.C.

Sunderland Whist Drive and Supper Dance.

The annual whist drive and supper dance of the staff of the Sunderland Gas Company and their friends was held in Mengs' Restaurant on Dec. 10. The company numbered about 160.

During the course of the evening, Mrs. Morton, wife of a Director of the Company, presented prizes in connection with the whist drive. An opportunity was taken to present Mr. C. C. Walmsley, the newly appointed General Manager and Secretary, to the gathering. He said he would like to take the opportunity of saying how pleased he was to be among them and that he felt he was going to be very happy in Sunderland. He thanked the staff for the very warm welcome already extended to him. A vote of thanks was proposed by Mr. W. Jobling to Mrs. Morton, who suitably responded.

Diaries, Calendars, &c., Received

Seasonable gifts in the form of diaries, calendars, &c., have been received from the undermentioned friends, whose good wishes are cordially reciprocated:

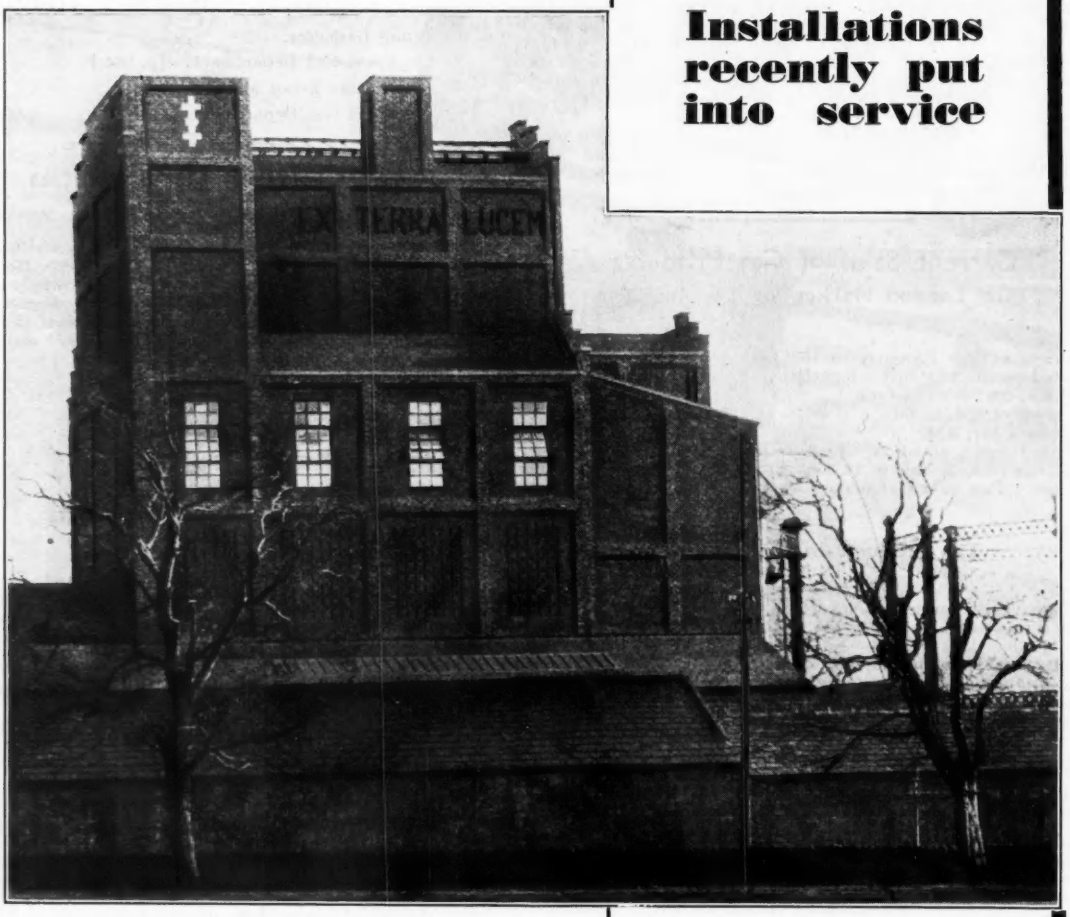
British Jeffrey-Diamond, Ltd., Wakefield.
Clay Cross Company, Ltd., nr. Chesterfield.
Gas Meter Company, Ltd., Kingsland Road, E. 2.
John G. Stein, Ltd., Bonnybridge.
Mavor & Coulson, Ltd., Bridgeton, Glasgow.
Parkinson & Cowan, Ltd., Stechford, Birmingham.
Staveley Coal and Iron Company, Ltd., nr. Chesterfield.
Sussex Daily News, Brighton.
William Guppy & Son, Ltd., Eldon Street, E.C. 2.

THE WEST SYSTEMS OF MODERN GAS AND COKE MANUFACTURE

GLOVER-WEST
VERTICAL RETORTS

THE SOCIETY OF BRITISH GAS INDUSTRIES · 1905 ·

Installations recently put into service



Carbonizing plants ordered or started up during 1937 bring the total installations of West design up to 416. The total of retorts or chambers involved is 10,732.

YEADON Continuous carbonization in Glover-West vertical retorts was adopted by the Yeadon and Guiseley Gas Company for their works modernization scheme of 1934. Smokeless operation was an important factor in the decision. The extension to this plant which began operation early in the present year has increased its production capacity by 50 per cent.

WEST'S GAS IMPROVEMENT COMPANY, LTD.

MANCHESTER: Albion Ironworks, Miles Platting — 'Phone: COLLYHURST 2961 : 'Grams: "STOKER, MANCHESTER"

LONDON: Columbia House, Aldwych, W.C.2 — 'Phone: HOLBORN 4108 : 'Grams: "WESGASCO, ESTRAND, LONDON"

STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Dec. 17.	Rise or Fall on Week.	Transaction Lowest and Highest Prices During the Week.
1,767,439	Stk.	Sept. 6	8	8	Alliance & Dublin Ord. ...	161—166	...	...
374,000	,,	Dec. 13	4	4	Do. 4 p.c. Deb. ...	93—98*	−2	...
558,890	,,	Aug. 9	7	7	Barnet Ord. 7 p.c.	158—163	...	...
300,000	1	Oct. 4	1/9⅜	1/4⅜	Bombay, Ltd.	26/—28/-	...	27/—27/6
179,915	Stk.	Aug. 9	9½	9½	Bournemouth sliding scale ...	200—205	...	...
590,407	,,	,,	7	7	Do. 7 p.c. max. ...	158—163	...	160—160½
493,960	,,	,,	6	6	Do. 6 p.c. Pref. ...	133—138	...	13 —135½
50,000	,,	Dec. 13	3	3	Do. 3 p.c. Deb. ...	78—83*	−1	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	97—102*	−1	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	115—120*	−1	...
357,900	,,	Aug. 9	7½	7½	Brighton, &c., 6 p.c. Con. ...	150—155	...	...
649,955	,,	,,	6¾	6¾	Do. 5 p.c. Con. ...	133—138	...	133½
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	127—133	...	...
855,000	,,	Sept. 20	8	7	British Ord.	139—144	−6	139½—144
100,000	,,	Dec. 13	7	7	Do. 7 p.c. Pref.	140—145*	−3	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	110—115*	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—100*	...	95½—96¾
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	102—107*	...	...
450,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100*	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1⅛—2¼	...	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1⅛—3¼	...	...
150,000	Stk.	Dec. 13	4½	4½	Do. 4½ p.c. Deb. ...	77—82*	−2	...
626,860	,,	July 19	6	6	Cardiff Con. Ord.	125—130	...	126½—127½
237,860	,,	Dec. 13	5	5	Do. 5 p.c. Red. Deb.	106—111*	−1	...
98,936	1	Oct. 4	2/-	2/-	Colombo Ord.	1⅞—1¾	...	...
24,510	1	,,	1/4⅜	1/4⅜	Do. 7 p.c. Pref. ...	23/6—25/6	...	...
739,453	1	Oct. 4.	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	17/—19/-	...	...
296,144	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref.	22/—24/-	...	...
1,775,005	Stk.	Aug. 9	5	5	Commercial Ord.	80—85	...	82½
620,000	,,	Nov. 29	3	3	Do. 3 p.c. Deb. ...	73—78	...	...
286,344	,,	Aug. 23	5	5	Do. 5 p.c. Deb. ...	113—118	...	...
807,560	,,	Aug. 9	7	7	Croydon sliding scale ...	140—145	...	143½—145
644,590	,,	,,	5	5	Do. max. div.	110—113	...	110½—111½
620,385	,,	Dec. 13	5	5	Do. 5 p.c. Deb.... ...	112—117*	−1	115
239,000	,,	Aug. 9	5	5	East Hull Ord. 5 p.c.... ...	98—103	...	...
185,355	,,	Aug. 9	6	6	East Surrey Ord. 5 p.c. ...	120—125	...	...
176,211	,,	Dec. 13	5	5	Do. 5 p.c. Deb. ...	112—117*	−1	...
250,000	1	Nov. 15	7	4	Gas Consolidation Ord. ...	19/6—21/6	...	...
250,000	1	,,	4	4	Do. 4 p.c. Red Cum. Pref.	18/6—20/6	...	...
19,255,284	Stk.	Aug. 9	5⅜	5⅜	Gas Light & Coke 4 p.c. Ord.	24/6—25/6a	−/6	24/9—25/6
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.... ...	83—86	...	85⅜
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	100—103	...	102—102½
2,993,000	,,	July 5	...	3¾	Do. 3¾ p.c. Red. Pref.	101—103	...	102—102½
8,602,497	,,	Nov. 29	3	3	Do. 3 p.c. Con. Deb. ...	78—81*	...	79—80½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	112—115	...	113½—113½
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb....	110—113	...	111½—112¾
700,000	,,	Sept. 6	3¼	3¼	Do. 3¼ p.c. Red. Deb....	98—101	...	98¼—99½
270,466	,,	Aug. 23	6	6	Harrogate New Cons. ...	115—120	...	...
213,200	,,	Aug. 9	6	6	Hornsey Con. 3½ p.c. ...	118—123	...	119—120
5,600,000	,,	Nov. 1	12	8	Imperial Continental Cap. ...	135—140	−2	136½—140½
223,130	,,	July 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	89—94	...	...
285,242	,,	Aug. 9	8½	8½	Lea Bridge 5 p.c. Ord. ...	170—175	...	...
75,000	,,	Nov. 29	†10	†10	Malta & Mediterranean ...	145—155	...	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—103	...	...
231,978	Stk.	Aug. 23	5	5	M.S. Utility 'C' Cons. ...	101—106	...	...
968,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	96—101	...	
360,075	,,	Dec. 13	4	4	Do. 4 p.c. Deb. ...	97—102*	...	...
148,955	,,	,,	5	5	Do. 5 p.c. Deb. ...	112—117*	−3	...
675,000	,,	Nov. 15	†9	†6	Montevideo, Ltd.	85—90	...	86—87½
250,000	,,	Aug. 9	7½	7½	North Middlesex 6 p.c. Con.	147—152	...	...
396,160	,,	Aug. 9	5	5	Northampton 5 p.c. max. ...	110—115	...	110
300,000	,,	Oct. 18	†7	†9	Oriental, Ltd....	153—158	...	...
468,537	,,	Dec. 13	8	8	Plymouth & Stonehouse 5 p.c.	154—159*	−3	...
621,667	,,	Aug. 9	8½	8½	Portsmouth & Gosport Cons.	164—169	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	104—109	...	...
73,350	,,	,,	5	5	Do. 5 p.c. Pref. ...	110—115	...	...
441,275	1	Sept. 20	1/1½	1/1½	Severn Val. Gas Cor. Ld. Ord.	21/6—23/6	...	21/6—21/7½
460,810	1	,,	-/10½	-/10½	,, ,, 4½ p.c. Cum. Pref.	19/6—21/6	...	20/
133,201	Stk.	Aug. 23	5	8½	Shrewsbury 5 p.c. Ord. ...	130—135	...	...
1,371,752	1	Sept. 6	1/2⅜	1/2⅜	South East'n Gas. Cn.Ld. Ord.	23/—25/-	...	23/9—24/9
871,636	1	,,	-/10½	-/10½	Do. 4½ p.c. Red. Cum. Pref.	20/—22/-	...	21/-
498,818	1	,,	4	4	Do. 4 p.c. Cum. Pref. ...	18/—20/	...	...
450,000	Stk.	Aug. 9	4	4	Do. 4 p.c. Deb.	99—102	...	...
150,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	96—99	...	...
6,709,895	,,	Aug.	6	5	South Met. Ord.	101½—103½	...	102—103
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf. ...	131—136	...	134
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf. ...	98—101	...	...
1,895,445	,,	Dec. 13	3	3	Do. 3 p.c. Deb. ...	74—79*	−1	77—78
1,000,000	,,	July 5	5	5	Do. 5 p.c. Red. Deb....	110—113	...	111½
1,543,795	,,	Aug. 9	6	6	South Suburban Ord. 5 p.c....	120—125	...	124
512,825	,,	,,	5	5	Do. 5 p.c. Pref....	110—115	...	...
500,000	,,	,,	4	4	Do. 4 p.c. Pref....	95—100	...	...
250,000	,,	,,	...	§18/9	Do. 3¾ p.c. Red. Pref.	98—101	...	100
888,587	,,	Dec. 13	5	5	Do. 5 p.c. Deb....	113—118*	−2	117
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	97—100*	−1	...
200,000	,,	Sept. 20	...	3½	Do. 3½ p.c. Red. Deb.	94—99	...	...
427,859	1	Nov. 1	1/2⅜	9½	S. Western Gas & Water Ord.	18/6—20/6	...	18/6—19/-
160,523	1	,,	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pf.	19/6—21/6	...	...
110,000	Stk.	Dec. 13	4	4	Do. 4 p.c. Red. Deb. ...	97—102*	...	...
750,541	,,	Aug. 9	5½	5	Southampton Ord. 5 p.c. ...	111—116	...	...
148,836	,,	Dec. 13	4	4	Do. 4 p.c. Deb.	96—101*	−1	...
350,000	,,	Aug. 23	5½	5½	Swansea 5½ p.c. Red. Pref. ...	110—115	...	...
94,000	,,	June 7	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
1,076,490	,,	Aug. 9	6⅜	6⅜	Tottenham and District Ord.	132—137	...	...
409,835	,,	,,	5½	5½	Do. 5½ p.c. Pref....	121—126	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	109—114	−1	...
371,850	,,	Dec. 13	4	4	Do. 4 p.c. Deb. ...	97—102*	...	...
888,629	1	Oct. 4	6	4	U. Kingdom Gas Cor. Ord.	19/6—21/6	−/6	19/10½—20/4½
937,743	1	Nov. 15	4½	4½	Do. 4½ p.c. 1st Cum. Pref.	20/—22/-	...	19/6—20/3
745,263	1	Dec. 13	4½	4½	Do. 4½ p.c. 2nd Non-Cum. Pf.	16/6—18 6*	−/6	...
1,000,000	Stk.	Sept. 20	3½	3½	Do. 3½ p.c. Red. Deb. ...	96—99	...	...
373,939	,,	Aug. 9	7	7	Uxbridge, &c., 5 p.c. ...	138—143	...	...
133,010	,,	,,	5	5	Do. 5 p.c. Pref. ...	109—114	...	...
1,371,138	,,	Aug. 9	7	7	Wandsworth Consolidated ...	140—145	...	141½—143
2,525,768	,,	,,	4	4	Do. 4 p.c. Pref. ...	99—102	...	...
1,343,964	,,	Dec. 13	5	5	Do. 5 p.c. Deb. ...	113—118*	−2	...
383,745	,,	,,	4	4	Do. 4 p.c. Deb. ...	97—102*	...	100
558,342	,,	Aug. 9	7	7	Watford and St. Albans Ord.	140—145	...	...
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	109—114	...	...
200,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	121—126	...	...
200,000	,,	Nov. 29	4	4	Do. 4 p.c. Red. Deb.	95—100	...	...
100,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb.	94—99	...	...

a.—The quotation is per £1 of Stock. * Ex div. † Paid free of income-tax. ‡ For year. § Actual.

Stock and Share List continued overleaf.

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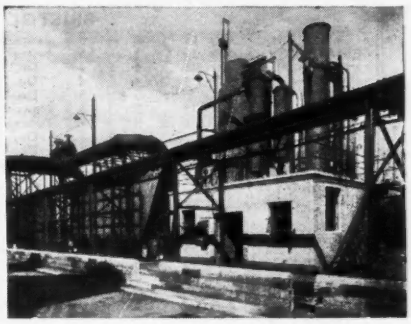

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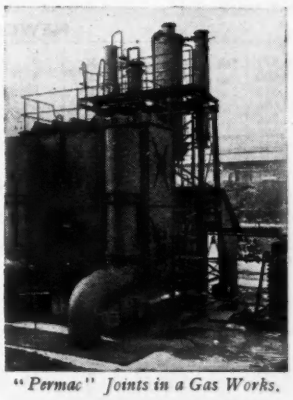

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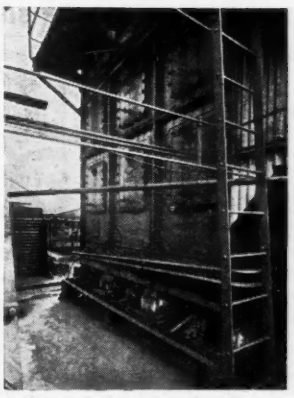

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Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Dec. 17	Rise or Fall on Week.	Transactions Lowest and Highest During the Week.
BRISTOL EXCHANGE.								
347,756	Stk.	July 19	6	5	Bath Cons.	120—122	...	...
1,667,250	,,	July 19	5	5	Bristol, 5 p.c. max.	116—117	...	...
120,420	,,	Dec. 13	4	4	Do. 1st 4 p.c. Deb. ...	99—101*	−1½	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	99—101*	−1½	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	118—121*	−2	...
274,000	,,	July 19	5	5	Newport (Mon.) 5 p.c.max. ...	100—105	...	...
13,200	12	Sept. 6	8	7	Pontyp'l Gas & W. 10 p.c. 'A'	13—14	...	...
13,600	10	,,	6	5	Do. 7 p.c. 'B'	11⅞—12⅜	...	...
40,000	10	,,	6	5	Do. 7 p.c. 'C'	11⅞—12⅜	...	...
140,778	Stk.	Aug. 9	5	5	Weston-super-Mare Cons. ...	110—112	...	...
64,338	,,	June 21	4	4	Do. 4 p.c. Deb.	96—98	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	157—160	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Aug. 9	6½	5	Chester 5 p.c. Ord.	104—109	...	...
92,500	,,	Dec. 13	4	4	Do. 4 p.c. Pref.	96—100*	−1	...
36,430	,,	,,	3½	3½	Do. 3½ p.c. Deb.... ...	88—91*	−1	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	97—101*	−1	...
2,167,410	,,	Aug. 23	6	6	Liverpool 5 p.c. Ord. ...	125½—127½	...	...
245,500	,,	Dec. 13	5	5	Do. 5 p.c. Red. Pref. ...	99—104*	...	...
306,083	,,	July 1	4	4	Do. 4 p.c. Deb. ...	102—104	...	...
106,280	,,	Aug. 9	10	10	Preston 'A' 10 p.c.	206—216	...	...
188,219	,,	,,	7	7	Do. 'B' 7 p.c.	147—157	...	...
NEWCASTLE EXCHANGE.								
122,577	Stk.	Aug. 9	8	8	Blyth 5 p.c. Ord.	165—166	...	...
732,000	,,	Aug. 9	5	5	Hartlepool G. & W. Co. & New	112—114	...	...
2,061,315	,,	Aug. 9	5⅝	5	Newcastle & Gateshead Con.	23/3—23/9a	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	98—100	...	...
776,706	,,	June 21	3½	3½	Do. 3½ p.c. Deb. ...	90½—91½	...	...
277,285	,,	Nov. 1	5	5	Do. 5 p.c. Deb. '43...	103—105	...	...
332,351	,,	Aug. 23	6	6	Sunderland 6 p.c. max. ...	139—141	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Aug. 9	9	6	Derby Con.	135—145	...	...
55,000	,,	Dec. 13	4	4	Do. 4 p.c. Deb.	100—105*	...	...
20,000	10	Dec. 13	5	5	Long Eaton 5 p.c. Pref. ...	10—12*	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	105—110*	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Sept. 20	10	10	Great Grimsby 'A' Ord. ...	210—220	...	...
6,500	,,	,,	10	10	Do. 'B' Ord. ...	210—220	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—210	...	...
1,806,339	,,	Aug. 23	6	6½	Sheffield Cons.	144—148	...	...
95,000	,,	July 5	4	4	Do. 4 p.c. Deb.... ...	100—103	...	...
Supplementary List of Stocks and Shares not Officially Quoted								
202,152	Stk.	Sept. 6	25/-b	5	Ascot Ord.	100—105	...	...
128,182	,,	Dec. 13	5	5	Do. 5 p.c. Pref.	108—113*	...	...
573,156	1	Nov. 15	5	5	Assd. Gas and Water Ord. ...	19/—21/-	...	19/6—20/-
167,506	1	,,	...	-/4c	Do. 4 p.c. Red. Cum. Pref.	19/—20/-	...	20/-
253,118	1	,,	...	4	Do. 4 p.c. Irred Pref. ...	18/—20.-	...	20/-
500,000	1	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/—21/-	...	20.-
500,000	Stk.	Sept. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
31,035	1	Aug. 23	...	-/4½	Associated Utilities 4 p.c. Pref.	16/6—18.6	...	...
100,000	Stk.	Dec. 13	...	3½	Do. 3½ p.c. Red. Deb.	95—100*	...	...
17,000	,,	Aug. 23	8	8	Bognor Orig. Ord. 'A' ...	160—170	...	...
62,210	,,	,,	8	8	Do. New Addl. 'A' ...	160—170	...	...
87,160	,,	,,	7	7	Do. New 7 p.c. max. ...	141—146	...	...
37,440	,,	Aug. 9	10	10	Cam. Univ. & Town 10 p.c.max.	193—203	...	...
125,970	,,	,,	7	7	Do. 7 p.c. max.	135—140	...	...
39,025	,,	,,	5	5	Do. 5 p.c. max.	98—103	...	...
65,000	,,	Aug. 9	8½	7½	Eastbourne 'A' 5 p.c. ...	158—163	...	...
198,000	,,	,,	7	6	Do. 'B' 3½ p.c.	128—133	...	...
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
130,000	,,	Dec. 13	5	5	Do. 5 p.c. Deb.	113—116*	−2	113
24,000	30	Aug. 23	8½	8½	Great Yarmouth 8½ p.c. max.	44—49	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.	34—39	...	...
51,160	Stk.	Dec. 13	5½	5½	Do. 5½ p.c. Deb.	120—125*	...	...
152,600	,,	Sept. 6	9	8	Guildford Cons.	170—175	...	...
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	110—115	...	...
68,250	,,	Dec. 13	5	5	Do. 5 p.c. Deb.	112—117*	−1	...
156,600	,,	Aug. 23	7½	7½	Hampton Court Cons. ...	158—163	...	...
73,620	,,	Sept. 6	8½	8½	Luton Cons. 'A'	163—168	...	...
107,960	10	Sept. 20	5½	4	Mid Kent Ord.	8¾—9¾	...	...
230,940	Stk.	Aug. 9	10	10	Oxford & District Ord. ...	205—210	...	...
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	110—115	...	...
126,193	,,	Nov. 15	7½	7½	Peterborough Ord.	158—163	...	...
64,990	,,	Sept. 6	7½	6½	Redditch Ord.	125—135	...	...
166,850	,,	Aug. 9	8	8	Romford Ord.	155—160	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Sept. 20	5	5	Do. 5 p.c. Deb.	113—118	...	...
25,570	,,	Aug. 9	5½	5½	Rugby 5½ p.c. Pref.	125—130	...	...
25,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	106—111	...	...
42,750	,,	Dec. 13	5½	5½	Do. 5½ p.c. Deb.	120—125*	−2	...
10,950	,,	Aug. 23	8	8	Ryde Ord.	158—163	...	...
270,086	,,	Sept. 6	7	7	Slough Ord.	135—140	...	...
21,000	,,	Dec. 13	5	5	Do. 5 p.c. Deb.... ...	110—115*	...	...
28,872	1	Nov. 1	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	19/—21/-	...	...
28,866	1	Sept. 6	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	18/6—20/6	...	...
137,730	Stk.	Aug. 9	7	7	Southgate & Dist. 7 p.c. max.	140—145	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	110—115	...	...
117,228	,,	Aug. 23	5	5	Swindon Cons.	106—111	...	...
60,425	,,	Dec. 13	5	5	Do .5 p.c. Deb.	110—115*	...	...
64,380	,,	Dec. 13	5	5	Torquay and Paignton 5 p.c. Pf	108—113*	−2	...
500,000	1	Nov. 15	...	-/1·15c	United Kingdom Gas Corpn. 4 p.c. 1st Red. Cum. Pref.	19/—21/-	...	19/6—20/-
33,858	1	,,	...	-/2·70c	Do. 4½ p.c. 1st. Cum Pref.	20/—22/-	...	20/6
130,000	Stk.	Aug. 9	8	5	Wakefield Ord.	120—125	...	...
81,650	,,	,,	5	5	Do. 5 p.c. max.	103—108	...	...
82,000	,,	Aug.	6	6	Weymouth Ord.	103—108	...	...
98,384	,,	Aug. 9	6	6	Wolverhampton 6 p.c. Pref....	120—125	...	...
160,000	,,	Dec. 13	5½	5½	Do. 5½ p.c. Rd. Db	107—112*	−1	...
90,000	,,	Dec. 13	5	5	York 5 p.c. Red. Deb. ...	104—109*	−1	...
133,640	,,	July 19	6½	6½	Yorktown (Cam.) 5 p.c Cons.	128—133	...	...
120,000	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
35,000	,,	Dec. 13	5½	5½	Do. 5½ p.c. Deb.... ...	121—126*	−2	...

a The quotation is per £1 of Stock. b Actual for Quarter. c Actual. * Ex div.

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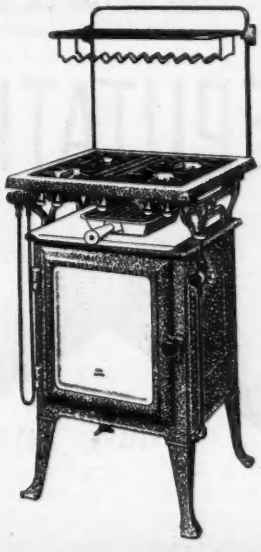

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